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[redacted] DET 5/2 D

megger

Digital Earth Testers
MEGGER® DET3/2, DET5/2 & DET5/2D

Operating Instructions
Mode d'Emploi
Instrucciones de Uso

MEGGER®

SAFETY WARNING

★ ***The earth spikes, test leads and their terminations must not be touched if an installation earth-fault can arise, unless adequate precautions are taken.***

★ ***When working near high tension systems rubber gloves and shoes should be worn.***

★ ***Special precautions are necessary when "live" earths may be encountered, and isolation switches and fuses are needed in this situation.***

★ ***The terminals of the DET5/2 must be disconnected from any external circuit while its battery cells are being charged. The DET5/2D must be similarly disconnected while its battery cells are changed.***

★ ***Before charging the DET5/2 battery ensure that the correct supply fuse is fitted and the voltage selector is set correctly.***

Refer also to page 14 for further explanations and other precautions.

The warnings and precautions must be read and understood before the instrument is used. They must be observed during use.

NOTE

2 ***The instrument is only to be used by a suitably trained and competent person.***

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GENERAL DESCRIPTION

The DET3/2, DET5/2 and DET5/2D MEGGER® Digital Earth Testers are compact instruments designed to measure earth electrode resistance, earth continuity etc. They may also make earth resistance tests which lead to the measurement of soil resistivity. The DET3/2 is powered by a hand cranked generator whereas the DET5/2 has an internal rechargeable battery, with an integral charger unit. The DET5/2D is powered from six internal, replaceable alkaline cells.

TEST METHOD

Each instrument uses the well known four-terminal method of measurement in which the resistance of the current circuit test leads does not affect the result. In the DET3/2, DET5/2 and DET5/2D the resistance of the potential circuit test leads can also be ignored because a buffer stage is incorporated to prevent the measuring circuit from loading the earth resistance under test.

A simple, latchable, push-button switch provides a three-terminal measurement by internally connecting the 'C1' and 'P1' terminal sockets together.

A reversing d.c. test current, generated electronically from a "floating" constant current source within the instrument, is passed via the 'C1' and 'C2' terminals through the earth being tested. The potential developed across the earth is compared with the current and, after filtering and phase sensitive detection, the resistance is given directly on the digital display.

The test frequency is 128 Hz and in the interests of safety the maximum test voltage at the terminals is limited to 50 V (peak) with respect to earth. Short circuit current is either 10 mA, 1 mA or 100 μA depending on the range in use.

INSTRUMENT DESIGN

The instruments are very robust and have tough cases moulded in ABS plastic. Each case is fitted with a fold-down carrying handle and four right-angled adaptors are supplied to connect the test leads to the instrument terminals. Test leads are not supplied with an instrument but form part of an earth testing field accessory kit which is available as an additional option. This kit also includes test spikes (electrodes), a hammer and spike extractors.

All instruments have simple controls. Mounted on the front panel is a rotary range selector and two push-button switches, one for checking the potential circuit resistance prior to a measurement being made and the other for connecting the 'C1' and 'P1' terminals internally for a three-terminal measurement. The instrument's 3½ digit liquid crystal display shows the test result and also indicates a high current circuit

resistance, a high potential circuit resistance, (both usually caused by a high test spike resistance), a "noisy" environment within the earth making up the test sample, and a low battery voltage in the case of the DET5/2 and DET5/2D, or low generator cranking speed in the case of the DET3/2. As these factors can influence the measurement being made, noise and the current circuit resistance are continuously monitored during a test, while a check of the potential circuit resistance can be made at any time. The display shows all measurements directly in ohms with the decimal point automatically positioned. It also gives an over-range indication to instruct the user to change to a higher range, and a negative sign to show that the current and potential test leads are reversed.

The battery powered testers both have an automatic switch-off after 3 minutes of measurement.

These testers have been designed to comply with the performance specifications of both the BS CP 1013 (1965) specification (from BSI) and the VDE 0413 Part 7 (1982) German specification. For this reason each terminal is marked in a dual way i.e.:—

C1	P1	P2	C2
E	ES	S	H

The terminal C1(E) is for the current connection to the earth electrode to be tested.
The terminal P1(ES) is for the potential connection to the earth electrode to be tested.
The terminal P2(S) is for the connection to the remote potential test spike.
The terminal C2(H) is for the connection to the remote current test spike.

In terms of safety the instruments meet, in general, the requirements of BS 4743 (1979), IEC 348 (1978) and VDE 0411 (1981).

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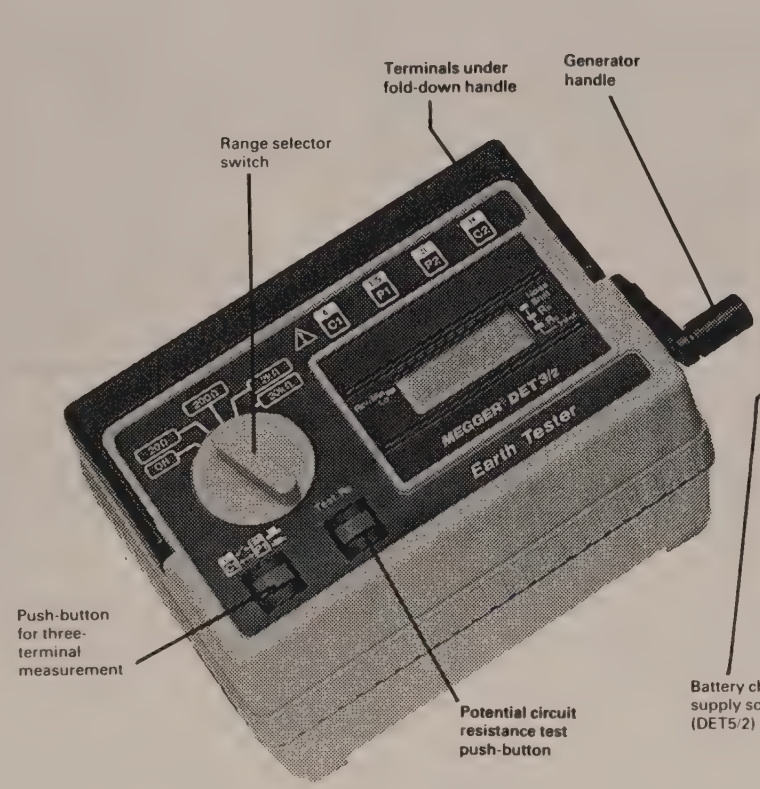
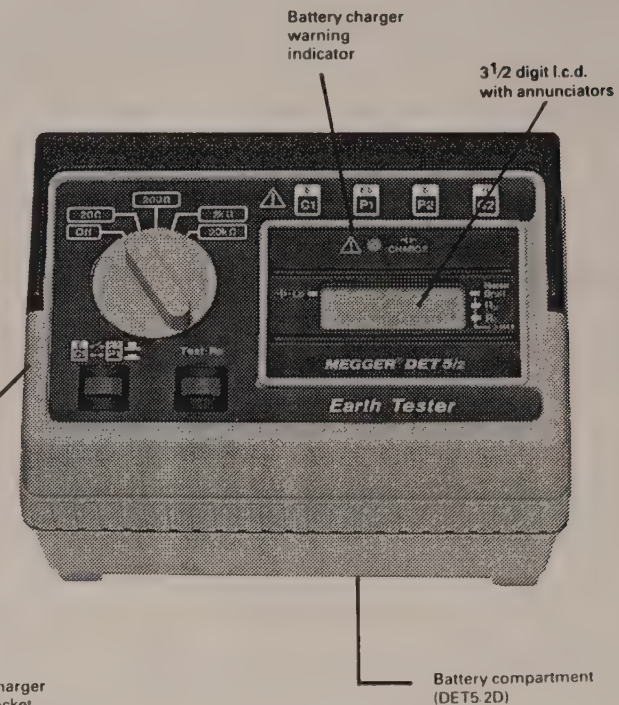


DET3/2



DET5 2
(DET5 2D is similar)

APPLICATIONS

The installation of satisfactory earthing systems is an essential part of electricity supply, wiring safety and installation economics. It is also of great importance in many communications systems.

The primary application of the DET3/2, DET5/2 and DET5/2D is in the testing of earth electrodes, whether these take the form of a single electrode, multiple electrodes, mesh systems, earth plates or earth strips. All earthing arrangements should be tested immediately after installation and at periodic intervals thereafter.

CHOICE OF ELECTRODE SITE

For an earth electrode or system to perform satisfactorily it must always have a low total resistance to earth. This value will be influenced by the specific resistance of the surrounding soil. This in turn depends on the nature of the soil and its moisture content. Before sinking an electrode or electrode system therefore, it is often helpful to survey the surrounding area before choosing the final position for the electrode. It is possible with these instruments to obtain the resistivity of the soil over an area and at different levels beneath the surface of the ground. These resistivity surveys may show whether any advantage is to be gained by driving electrodes to a greater depth, rather than increasing the cost by having to add further electrodes and associated cables, in order to obtain a specified total earth system resistance.

EARTHING SYSTEM MAINTENANCE

After installation, checks may be made on an earthing system to see if there is any significant change in the resistance over a period of time or under different soil moisture conditions, (e.g. brought about by changing weather conditions or different seasons of the year). Such checks will indicate when there is a need for maintenance of the installation because the required resistance to earth has been exceeded by changing conditions or the ageing of the system.

OTHER APPLICATIONS

For archaeological and geological purposes, an investigation of soil structure and building remains can be carried out at varying measured depths, by the resistivity survey technique.

In all cases the accuracy of the instrument readings may be taken to be higher than the changes caused by natural variables in soil characteristics.

A further application is in continuity testing, e.g. checking the resistance of conductors used in an earthing circuit.

Resistances between 0,01 Ω and 19,99 kΩ can be measured with a basic accuracy of ±2% of reading ±3 digits. Individual test spike resistances of up to 4 kΩ for the current loop or 10 kΩ for the potential loop can be tolerated on the lowest range, and on the higher ranges greater values can exist.

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WARNINGS

1. As a precaution when working near high tension systems where accidental high potentials on the structure and in the ground are possible, it is recommended that the operator wears rubber gloves (to BS 697:1986) and stands on a rubber mat or wears rubber shoes. (See para. 3 below).
2. It is preferable that the earth system to be tested is first isolated from the circuit it is protecting. This is not always possible and so the precaution below is most important.
3. **Safety precautions for all live earths**
   Safety precautions are necessary when any live earths may be encountered e.g. when testing the earth of a "live" substation. If a fault occurs at the substation while a test is being conducted, dangerous voltages may exist between the site earth and remote earths established for test purposes. Therefore:—
   a) The instrument must be used within the perimeter fence of the substation where the test is being conducted, and/or in an area where the voltage difference from the earth under test does not exceed 50 V in any circumstances. If this is not possible then rubber gloves and mats must be used.
   b) The P1 and C1 (or ES and E) terminals must be connected to the earth electrode being tested.
   c) The P2 and C2 (or S and H) terminals must be connected to an isolation switch, whose rating will cope with the maximum fault voltages (refer to Fig. 3).
   d) With the isolation switch open, connections to the remote test spikes (electrodes) may be established. Make the connections to the isolation switch first and then connect the remote test spikes (electrodes).
   e) When the remote test spikes have been established the isolation switch may be closed and a test made.
   f) Whilst the test is in progress care must be taken that no one comes into contact with the remote electrodes or the leads running to the P2 and C2 (or S and H) terminals via the isolation switch.
   g) The isolation switch must be open whilst any personal contact is made with the remote test spikes or the connecting leads, e.g. when changing their positions.
   h) If a fault occurs while a test is being made the instrument may be damaged. Incorporating fuses at the isolation switch, of rating 100 mA and able to cope with the maximum fault voltage, will provide some protection for the instrument (see Fig. 3).

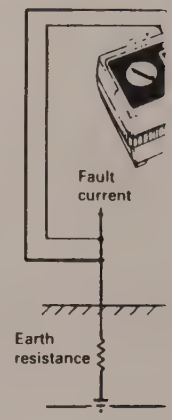


Fig. 3

OPERATION

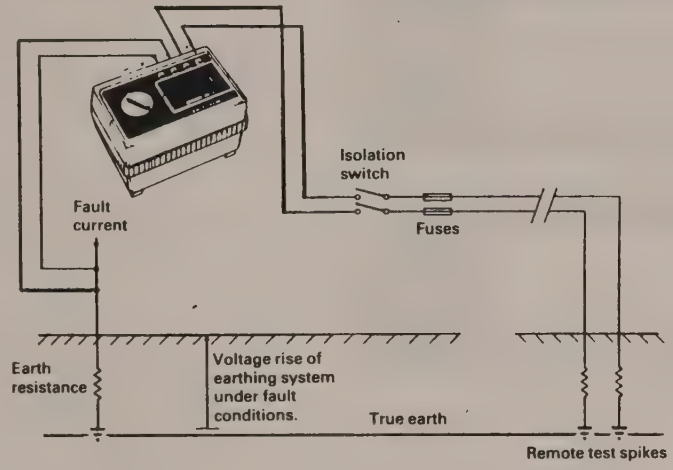


Fig. 3 A method of connection where fault conditions may occur

4. **When charging the DET5/2 battery:—**
   a) Ensure that the instrument is disconnected completely from any external circuit.
   b) Make sure before switching the supply on, that the correct setting of the voltage selector has been made and also that the correctly rated fuse for that supply has been fitted (see the Specification page 9).
   c) The socket to which the instrument is connected for battery charging should have an on/off switch.
5. Repairs to these instruments must only be carried out by suitably trained and qualified personnel.
6. If an instrument's protection has been impaired it should not be used and must be sent for repair. The protection is likely to be impaired if, for example, it shows visible damage, it fails to perform the intended measurements, it has been subjected to prolonged storage under unfavourable conditions, or it has been subjected to severe transport stresses.

PRECAUTIONS

1. The instrument circuit contains static sensitive devices. If the instrument casing is opened for any reason, care must be exercised in handling the printed circuit board. This should be done in accordance with DEF STAN 59-98 and BS 5783, specifications for handling electrostatic sensitive devices.

Note:— Opening the casing will automatically invalidate any warranty covering the instrument unless carried out by an approved repair organisation (see page 55).

2. It is advisable that, when working with the DET5/2 instrument, the battery is fully charged before embarking upon a test sequence. It can be extremely inconvenient if the battery voltage becomes too low while a field test is in progress. Similarly, with the DET5/2D new batteries should always be available.

DISPLAY SYMBOLS

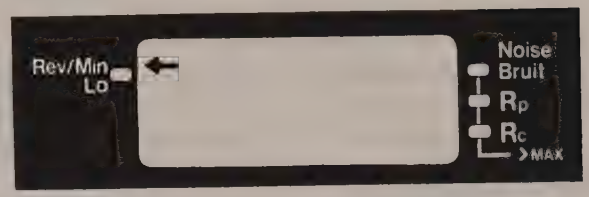
The 3½ digit l.c.d. shows the reading directly and the operator can simply refer to the range switch position for the units of measurement. The instrument's display symbols can also help the operator make certain that the reading is valid. The meaning of each display symbol is given in the following paragraphs.

Low Generator Cranking Speed (DET3/2)

If the generator handle on the DET3/2 is turned too slowly such that there is insufficient output for a test to be performed properly, an arrow '←' appears on the left of the display pointing at the 'Rev/Min Lo' mark on the graphics panel. Any reading on the display should be ignored and the generator turned faster until the arrow disappears before a measured value is accepted

Low Battery Voltage (DET5/2 and DET5/2D)

Similary on the DET5/2 and DET5/2D, if the battery voltage is too low the arrow on the left of the display will appear pointing at the ' ⊣⊢ Lo' mark on the graphics panel. In this case the batteries hold only enough power for possibly one or two more measurements and must be recharged (DET5/2) or replaced (DET5/2D) before further tests are undertaken.



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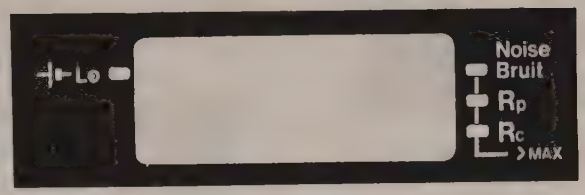

DET5/2 & DET5/2D

Fig. 4 Low cranking speed and low battery voltage indications.

Reverse Polarity

When the potential test leads are reversed with respect to the current test leads, the reading on the

display is preceded by a negative sign. The reading is still valid, but the potential connections should be reversed to remove the negative sign. For a positive measurement the 'C1' and 'P1' (or 'E' and 'ES') connections should go to the electrode being tested, i.e. to one end of the resistance, and the 'C2' and 'P2' (or 'S' and 'H') connections should go to the test spikes, i.e. the other end of the resistance.

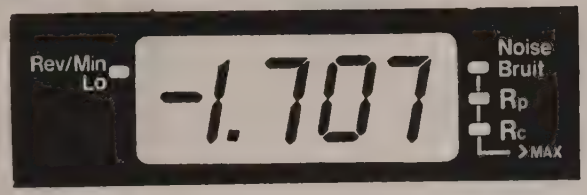

Fig. 5 Reverse polarity symbol

High Current Spike Resistance

To indicate that the resistance of the current circuit is too high, a display segment illuminates opposite the 'Rc' mark on the graphics panel. This happens automatically while the tester is switched on, even during a test. Its appearance may be caused by an open circuit or a poor connection in the test lead to the current spike, or, more likely, high resistance in the ground in the vicinity of the current spike and poor contact with that spike. Whatever the cause of the symbol's appearance it must be removed before a test can be regarded as valid. Moistening the ground around the current spike, re-siting the spike in a new position or using more than one spike may solve the problem.

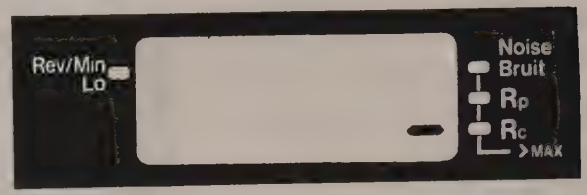

Fig. 6 High current spike resistance symbol.

High Potential Spike Resistance

To indicate that the resistance of the potential circuit is too high a display segment illuminates opposite the 'Rp' mark on the graphics panel. This does not happen automatically but should be a preliminary test carried out by the operator pressing the push-button marked 'Test Rp'. The reasons for its appearance may be the same as for the high current spike resistance symbol, and, as in that case, the problem must be removed before a test can be regarded as valid. Again the solution may be moistening the ground or re-siting the potential test spike.

Note:— Operating the 'Test Rp' button will cause the display to go blank except for the decimal point and high potential spike resistance symbol (when relevant).

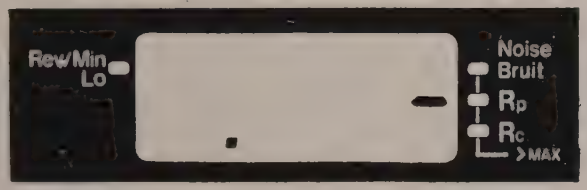

Fig. 7 High potential spike resistance symbol.

Excessive Noise Interference

A display segment will automatically appear opposite the 'Noise' mark on the graphics panel when the interference voltage in the earth being measured is beyond the level which can be rejected by the tester. A valid measurement cannot be made in this condition. The solution may be to wait until the interference has subsided if it is transient in nature or, to choose a different position for the test spikes.

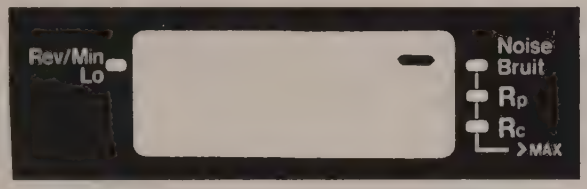

Fig. 8 Excessive noise interference symbol.

Note:— This symbol may also appear with the over-range indication if the resistance being measured is very much greater than the range selected.

Over-range

To indicate that the resistance being measured is above the range selected, the over-range symbol appears. This is a '1' as the left hand digit with the remainder of the display blank except for the decimal point. When this symbol appears switch to a higher range. If it appears on the '20 kΩ' range there is something seriously wrong with the earth electrode under test, (make sure in this case that the high current spike indicator is not showing — see page 17).

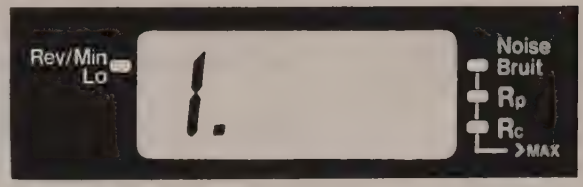

Fig. 9 Over-range symbol.

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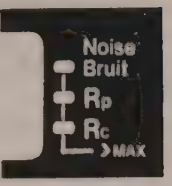

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SETTING-UP THE TEST SPIKES ETC.

For earth electrode testing and for earth resistivity surveying, the instrument's test leads are connected to spikes hammered into the ground. The way the connections are made depends on the type of test being undertaken and the details of these are given in the next section, 'Measuring Techniques'.

Test spikes and long test leads are necessary for all types of earth testing and the Earth Testing Field Accessory Kit, ET/KIT, (available as an option) contains the basic equipment.

Recommended test spikes are 13 mm square, or diameter 460 mm long and made of mild steel. These can be driven to a depth of 300 mm with rapid blows from a 1 kg hammer. The size of the cable suitable for use as test leads is not critical but, it should be reasonably flexible and MUST be insulated. At least 100 m length will be needed and a cable size of about 104/0,1 mm is suitable.

When connections are made to the instrument the right angled adaptors should be used. These are supplied with the instrument and they have screw terminals to take hook or spade connectors, bare wires, or 4 mm plugs.

BASIC TEST PROCEDURE

Four Terminal Measurement

After the test spikes have been set-up and connected to the instrument for the type of test to be carried out (refer to 'Measuring Techniques'), proceed as follows:—

1. Select the measuring range required. Choose the lowest range if it is uncertain which is correct; this may produce the over-range symbol when the instrument is operated, if so switch to the next range.
2. Turn the generator handle at 120 r.p.m. (minimum) for the DET3/2.
   Note:— The DET5/2 and DET5/2D energize the test circuit as soon as the range is selected.
3. Check that the display shows no adverse test conditions, i.e. that the high current circuit resistance and excessive noise symbols are not showing. Also check that the low battery voltage symbol (DET5/2 and DET5/2D) or low cranking speed symbol (DET3/2) is not illuminated.
4. Press the 'Test Rp' push-button to check the potential spike resistance. The high potential circuit resistance symbol should not appear. Release the push-button.
5. If all the conditions for a test are satisfactory the reading given on the display may be accepted as the earth resistance. If any of the display symbols, (except reverse polarity), illuminate, the cause of

the adverse condition must be removed before the reading can be accepted.

Three Terminal Measurement

The basic test procedure is the same as for the Four Terminal Measurement except that the latchable push-button marked 'C1 - P1' ('E - ES') should be pressed and left in its down position. Only one connection is then required from the 'C1' ('E') terminal to the electrode under test. For greatest accuracy this connection should be made with a short lead.

BATTERY CHARGING (DET5/2)

The battery should be charged as soon as the low battery indicator appears on the display. If the display remains blank when the instrument is switched on, it may be that the battery has become completely exhausted. In this case charge the battery fully before performing any tests.

Note:— It is unwise to allow the battery to become completely exhausted for fear of causing it damage.

Before connecting to the mains supply ensure that the correctly rated fuse is fitted and that the voltage adjuster is set to the right value for the supply to be used. For a 240 V a.c. supply the fuse should be 50 mA and for a 120 V a.c. supply the fuse should be 100 mA. (Type and size of the fuses are given in the Specification). The mains supply fuse is located in the holder which is part of the recessed input plug on the side of the case. Simply slide the holder out to reveal two fuses, the inner one is the working fuse; the outer one is a spare fuse. The voltage adjuster is located on the bottom of the casing. Use a screwdriver to turn the appropriate voltage mark to the indicating arrow.

When the fuse and voltage selector are correctly set, plug the mains supply lead into a suitable socket outlet and switch on. An l.e.d. light on the front panel marked '⊣■— CHARGE' will illuminate to show that the instrument is connected to a mains supply. Leave the battery to charge for 10 hours approximately.

Caution:— Do not leave the test leads connected to the terminals while the instrument is being supplied with mains power.

FITTING OR REPLACING BATTERY CELLS (DET5/2D)

Caution:— Use only battery cells of the correct type (see the Specification). Whenever the battery cells are being fitted or replaced there should be no connections to the instrument terminals.

Unscrew the cover from the battery compartment in the bottom of the case. Remove the old cells and fit each new cell the correct way round, as indicated in the battery compartment moulding. Replace the cover and tighten the securing screws fully.

Do not leave battery cells fitted in the compartment if the instrument will remain unused for a long time, to avoid damage by leaking electrolyte.

AUTOMATIC SWITCH-OFF (DET5/2 and DET5/2D)

To conserve battery power there is an automatic switch-off for these instruments which takes effect after 3 minutes of a test. To switch the instruments on again turn the range switch to the off position and then back to the range required.

This function is not intended as a replacement for the range switch 'Off' position (since it selects a low power mode). Whenever practicable the instrument should be switched off by setting the range switch to the 'Off' position; this will maximise battery life.

REPLACING THE CURRENT SOURCE PROTECTING FUSE

In addition to the DET5/2 mains supply fuse, both the DET3/2, DET5/2 and DET5/2D are fitted with a fuse to protect the output current source from input overloads, i.e. voltages applied to the C1 and C2 terminals.

This fuse is rated at 100 mA and is located in a holder in the base of the instrument case. To change this fuse use a screwdriver to unscrew the cap of the fuseholder; the fuse is clipped into this cap. Fit a new fuse and replace the cap.

Caution:— Any replacement fuse must be of the correct type and rating, (see the Specification).

FALL-OF-POTENTIAL METHOD

This is the basic method for measuring the resistance of earth electrode systems. However, it may only be practicable on small, single earth electrodes because of the limitation of the size of the area available to perform the tests.

Hammer the current test spike into the ground some 30 metres to 50 metres away from the earth electrode ('E') to be tested. Connect this spike to the instrument terminal 'C2' (or 'H').

Hammer the potential test spike into the ground mid-way between the current test spike and the earth electrode. Connect this spike to the instrument terminal 'P2' (or 'S').

Note:— It is important that the current spike, the potential spike and the earth electrode are all in a straight line. Also, when running the test leads out to these spikes (remote electrodes), it is preferable not to lay the wires close to each other in order to minimise the effect of mutual inductance.

Connect the 'C1' (or 'E') and the 'P1' (or 'ES') instrument terminals to the earth electrode 'E'. The diagram of Fig. 10 shows the connections.

Operate the instrument as explained in the 'Basic Test Procedure' on page 19, and note the resistance measurement obtained.

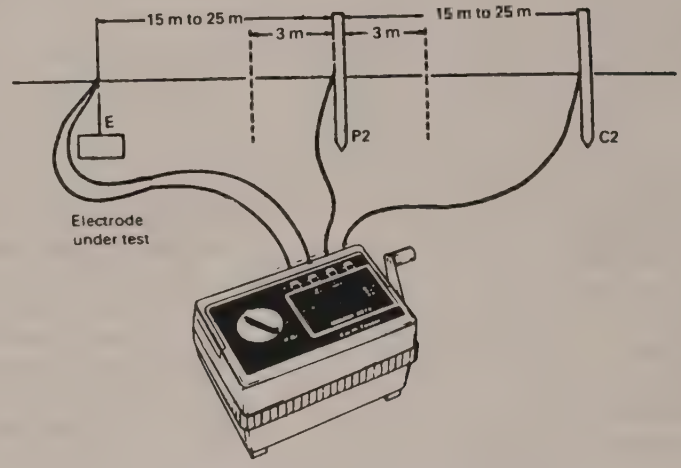

Fig. 10 Fall-of-Potential method for measuring resistance of an earth electrode.

Move the potential spike 3 metres farther away from the earth electrode and make a second resistance measurement. Then move the potential spike 3 metres nearer the earth electrode (than the original position) and make a third resistance measurement.

If the three resistance readings agree with each other, within the required accuracy, then their average may be taken as the resistance to earth of the electrode. If the readings disagree beyond the required accuracy then an alternative method should be used e.g. the 61,8% Rule or the Slope method etc.

Fall-of-Potential Method With Short 'E' Lead

Another way of making connections to the earth electrode 'E' is to join the 'P1' and 'C1' (or 'E' and 'ES') instrument terminals together and then connect both to the earth electrode 'E' using only one test lead, (as shown in Fig. 11). Press the button labelled 'C1-P1' ('E-ES') to automatically connect these two terminals internally. This should ONLY be done if the test lead can be kept short because its resistance will be included in the measurement.

Note:— Earth electrode test lead resistance can be determined separately. First remove it from the electrode 'E' and connect it to the 'C2' and 'P2' (or 'H' and 'S') terminals joined together, then measure its resistance in the normal way. This lead resistance can then be deducted from the earth resistance measurements. This procedure is not, of course, necessary if the 'C1' and 'P1' (or 'E' and 'S') terminals are connected by separate test leads.

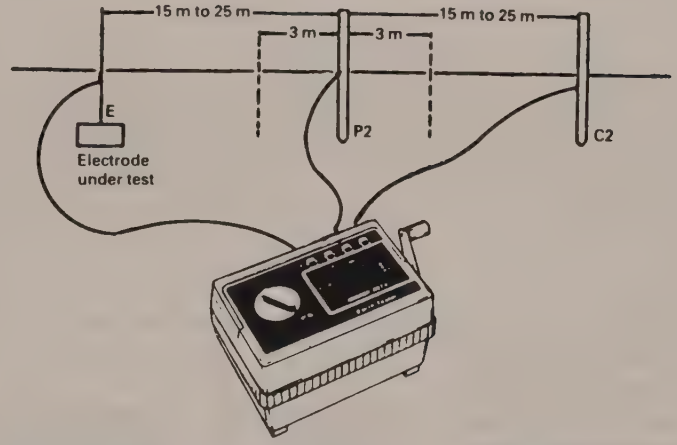

Fig. 11 Fall-of-Potential method using single lead to the earth electrode.

THE 61,8% RULE

To obtain a sensible reading using the Fall-of-Potential method the current spike must be correctly sited in relation to the earth electrode. Since both possess "resistance areas", the current spike must be sufficiently remote to prevent these areas overlapping. Furthermore, the potential spike must be between these two areas, see the diagram of Fig. 12. If these requirements are not met, the Fall-of-Potential method may give unsatisfactory results.

Fig. 12 Resist
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Fall-of-Potential
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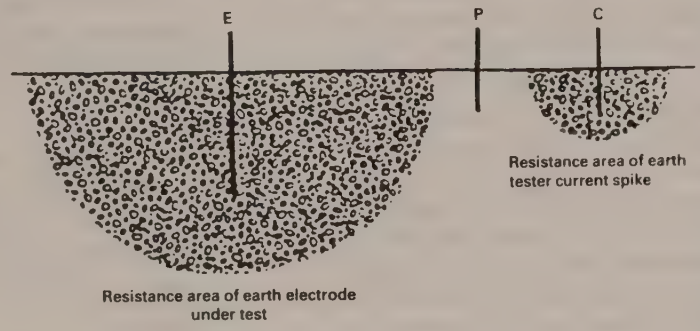

Fig. 12 Resistance areas associated with electrode and current spike.

Theoretically, both the current and potential spikes should be at an infinite distance from the earth electrode! However, by graphical considerations and by actual test it can be demonstrated that:—

The "true" resistance of the earth electrode is equal to the measured resistance when the potential spike is positioned 61,8% of the distance between the earth electrode and the current spike, away from the earth electrode.

This is the 61,8% Rule and strictly only applies when the earth electrode and both current and potential spikes are in a straight line, when the soil is homogeneous and when the earth electrode has a small resistance area that can be approximated by a hemisphere. Bearing these limitations in mind this method can be used, with care, on small earth electrode systems consisting of a single rod or plate etc. and on medium systems with several rods.

The diagram of Fig. 13 shows the layout for the 61,8% Rule.

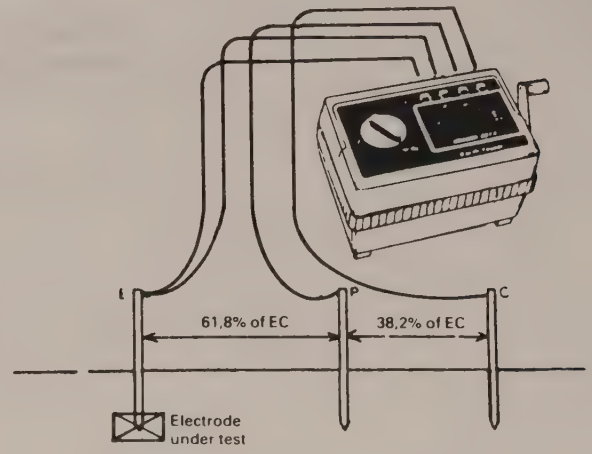

Fig. 13 The 61,8% Rule method.

For most purposes the current spike should be 30 metres to 50 metres from the centre of the earth electrode under test. The potential spike should be inserted in the ground 61,8% of this distance, between and in a straight line with, the current spike and the earth electrode. The distance is measured from the earth electrode.

If the earth electrode system is of medium size containing several rods, then these distances must be increased. The following table gives a range of distances which agree with the rule. In the first column "Maximum dimension" is the maximum distance across the earth electrode system to be measured.

Maximum dimension in metres	Distance to potential electrode in metres from centre of earth system	Distance to current electrode in metres from centre of earth system
5	62	100
10	93	150
20	124	200

For greater accuracy an average reading can be calculated by moving the current spike, say 10 metres, towards and then away from its first position and making further resistance measurements.

(Remember that the potential spike must also be moved in accordance with the 61,8% Rule). The average of the three readings can then be calculated.

THE SLOPE METHOD

This method is more applicable to larger earth electrode systems or where the position of the centre of the earthing system is either unknown or inaccessible (e.g. if the system is beneath the floor of a building). The Slope method can also be used if the area available for siting the test spikes is restricted. It can be tried if the previous methods prove unsatisfactory and generally yields results of greater accuracy than those methods.

The equipment is set-up as shown in Fig. 14. The remote current spike is placed 50 metres or more away from the earth electrode system to be measured and connected to the instrument's 'C2' (or 'H') terminal. The potential spike is inserted at a number of positions consecutively, between the earth system and the current spike, and connected to the 'P2' (or 'S') terminal. The test spikes and the earth system should all be in a straight line.

The instrument's 'C1' and 'P1' (or 'E' and 'ES') terminals are connected separately to some point on the earth electrode system.

Earth system

Fig. 14 Co

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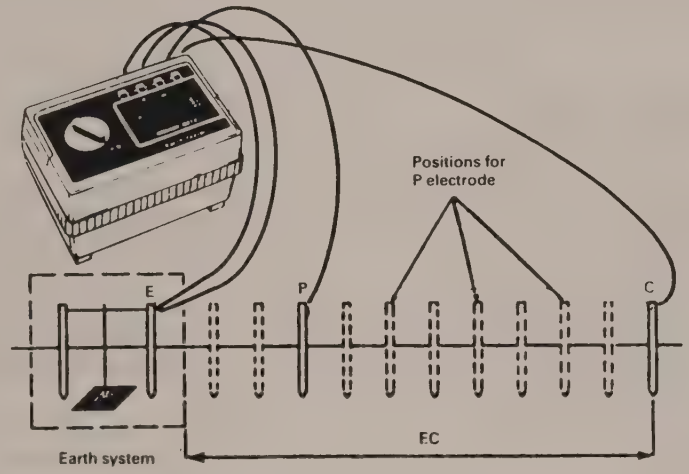

Fig. 14 Connections for the Slope method.

The earth resistance is measured at each separate position of the potential spike and the resistance curve plotted from the results. At least six readings are needed. The diagram of Fig. 15 shows an example. Drawing the curve will show up any incorrect points which may be either re-checked or ignored.

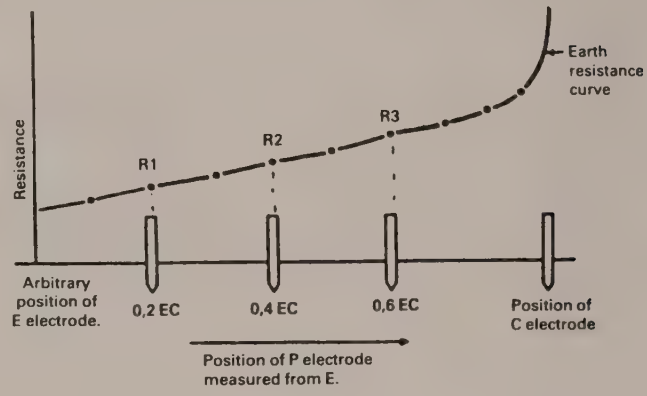

Fig. 15 Resistance curve from Slope method tests.

Suppose the distance from the earth electrode system to the current spike is EC. From the curve equivalent resistance readings to potential spike positions 0,2 EC, 0,4 EC and 0,6 EC can be found. These are called R1, R2 and R3 respectively.

Calculate the slope coefficient μ

where $$\mu = \frac{R3 - R2}{R2 - R1}$$

which is a measure of the change of slope of the earth resistance curve.

From the table on page 41 obtain the value of

$$\frac{P_T}{EC}$$

for this value of μ.

P_T is the distance to the potential electrode at the position where the true resistance would be measured.

Multiply the value of $\frac{P_T}{EC}$ by EC to obtain the distance P_T.

From the curve read off the value of resistance that corresponds to this value of P_T. The value obtained is the earth electrode system's resistance.

Notes:— (i) If the value of μ obtained is not covered in the table on page 41 then the current spike will have to be moved farther away from the earthing system.

(ii) If it is necessary, further sets of test results can be obtained with different values of EC, or different directions of the line of EC.
From the results obtained of the resistance for various values of the distance EC another curve can be plotted, as shown in Fig. 16 for example.

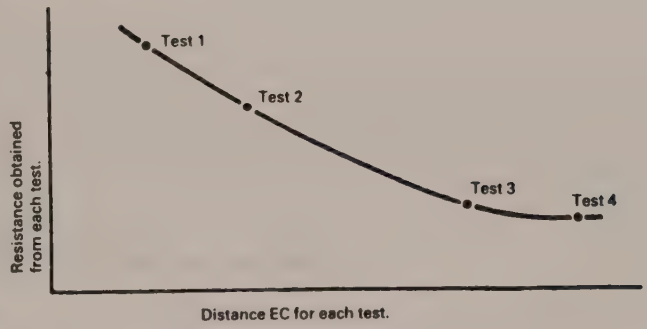

Fig. 16 Possible results from several Slope method tests.

This shows how the resistance is decreasing as the distance chosen for EC is increased.
The curve indicates that the distances chosen for EC in tests (1) and (2) were not large enough, and that those chosen in tests (3) and (4) were preferable because they would give the more correct value of the earth resistance.

(iii) It is unreasonable to expect a total accuracy of more than 5%. This will usually be adequate, bearing in mind that this sort of variation occurs with varying soil moisture conditions or non-homogeneous soils.

Chart for

VALUES OF P_T

μ	
0.40	0.6
0.41	0.6
0.42	0.6
0.43	0.6
0.44	0.6
0.45	0.6
0.46	0.6
0.47	0.6
0.48	0.6
0.49	0.6
0.50	0.6
0.51	0.6
0.52	0.6
0.53	0.6
0.54	0.6
0.55	0.6
0.56	0.6
0.57	0.6
0.58	0.6
0.59	0.6
0.60	0.6
0.61	0.6
0.62	0.6
0.63	0.6
0.64	0.6

Chart for use with the Slope method

VALUES OF P_1/EC for VALUES OF μ

μ	0	1	2	3	4	5	6	7	8	9
0.40	0.6432	6431	6429	6428	6426	6425	6423	6422	6420	6419
0.41	0.6418	6416	6415	6413	6412	6410	6409	6408	6406	6405
0.42	0.6403	6402	6400	6399	6397	6396	6395	6393	6392	6390
0.43	0.6389	6387	6386	6384	6383	6382	6380	6379	6377	6376
0.44	0.6374	6373	6372	6370	6369	6367	6366	6364	6363	6361
0.45	0.6360	6359	6357	6356	6354	6353	6351	6350	6348	6347
0.46	0.6346	6344	6343	6341	6340	6338	6337	6336	6334	6333
0.47	0.6331	6330	6328	6327	6325	6324	6323	6321	6320	6318
0.48	0.6317	6315	6314	6312	6311	6310	6308	6307	6305	6304
0.49	0.6302	6301	6300	6298	6297	6295	6294	6292	6291	6289
0.50	0.6288	6286	6285	6283	6282	6280	6279	6277	6276	6274
0.51	0.6273	6271	6270	6268	6267	6265	6264	6262	6261	6259
0.52	0.6258	6256	6255	6253	6252	6252	6248	6247	6245	6244
0.53	0.6242	6241	6239	6238	6236	6235	6233	6232	6230	6229
0.54	0.6227	6226	6224	6223	6221	6220	6218	6217	6215	6214
0.55	0.6212	6210	6209	6207	6206	6204	6203	6201	6200	6198
0.56	0.6197	6195	6194	6192	6191	6189	6188	6186	6185	6183
0.57	0.6182	6180	6179	6177	6176	6174	6172	6171	6169	6168
0.58	0.6166	6165	6163	6162	6160	6159	6157	6156	6154	6153
0.59	0.6151	6150	6148	6147	6145	6144	6142	6141	6139	6138
0.60	0.6136	6134	6133	6131	6130	6128	6126	6125	6123	6121
0.61	0.6120	6118	6117	6115	6113	6112	6110	6108	6107	6105
0.62	0.6104	6102	6100	6099	6097	6096	6094	6092	6091	6089
0.63	0.6087	6086	6084	6083	6081	6079	6076	6076	6074	6073
0.64	0.6071	6070	6068	6066	6065	6063	6061	6060	6058	6057

Chart for use with the Slope method (contd.)

μ	0	1	2	3	4	5	6	7	8	9
0.65	0.6055	6053	6052	6050	6049	6047	6045	6044	6042	6040
0.66	0.6039	6037	6036	6034	6032	6031	6029	6027	6026	6024
0.67	0.6023	6021	6019	6018	6016	6015	6013	6011	6010	6008
0.68	0.6006	6005	6003	6002	6000	5998	5997	5995	5993	5992
0.69	0.5990	5989	5987	5985	5984	5982	5980	5979	5977	5976
0.70	0.5974	5973	5971	5969	5967	5965	5964	5962	5960	5959
0.71	0.5957	5955	5953	5952	5950	5948	5947	5945	5943	5942
0.72	0.5940	5938	5936	5935	5933	5931	5930	5928	5926	5924
0.73	0.5923	5921	5920	5918	5916	5914	5912	5911	5909	5907
0.74	0.5906	5904	5902	5900	5899	5897	5895	5894	5892	5890
0.75	0.5889	5887	5885	5883	5882	5880	5878	5877	5875	5873
0.76	0.5871	5870	5868	5866	5865	5863	5861	5859	5858	5856
0.77	0.5854	5853	5851	5849	5847	5846	5844	5842	5841	5839
0.78	0.5837	5835	5834	5832	5830	5829	5827	5825	5824	5822
0.79	0.5820	5818	5817	5815	5813	5812	5810	5808	5806	5805
0.80	0.5803	5801	5799	5797	5796	5794	5792	5790	5788	5786
0.81	0.5785	5783	5781	5779	5777	5775	5773	5772	5770	5768
0.82	0.5766	5764	5762	5760	5759	5757	5755	5753	5751	5749
0.83	0.5748	5746	5744	5742	5740	5738	5736	5735	5733	5731
0.84	0.5729	5727	5725	5723	5722	5720	5718	5716	5714	5712
0.85	0.5711	5709	5707	5705	5703	5701	5699	5698	5696	5694
0.86	0.5692	5690	5688	5686	5685	5683	5681	5679	5677	5675
0.87	0.5674	5672	5670	5668	5666	5664	5662	5661	5659	5657
0.88	0.5655	5653	5651	5650	5648	5646	5644	5642	5640	5638
0.89	0.5637	5635	5633	5631	5629	5627	5625	5624	5622	5620

μ	
0.90	0.
0.91	0.
0.92	0.
0.93	0.
0.94	0.
0.95	0.
0.96	0.
0.97	0.
0.98	0.
0.99	0.
1.00	0.
1.01	0.
1.02	0.
1.03	0.
1.04	0.
1.05	0.
1.06	0.
1.07	0.
1.08	0.
1.09	0.
1.10	0.
1.11	0.
1.12	0.
1.13	0.
1.14	0.

8	9
042	6040
026	6024
010	6008
993	5992
977	5976
960	5959
943	5942
926	5924
909	5907
892	5890
875	5873
858	5856
841	5839
824	5822
806	5805
788	5786
770	5768
751	5749
733	5731
714	5712
696	5694
677	5675
659	5657
640	5638
622	5620

μ	0	1	2	3	4	5	6	7	8	9
0.90	0.5618	5616	5614	5612	5610	5608	5606	5604	5602	5600
0.91	0.5598	5596	5594	5592	5590	5588	5586	5584	5582	5580
0.92	0.5578	5576	5574	5572	5570	5568	5565	5563	5561	5559
0.93	0.5557	5555	5553	5551	5549	5547	5545	5543	5541	5539
0.94	0.5537	5535	5533	5531	5529	5527	5525	5523	5521	5519
0.95	0.5517	5515	5513	5511	5509	5507	5505	5503	5501	5499
0.96	0.5497	5495	5493	5491	5489	5487	5485	5483	5481	5479
0.97	0.5477	5475	5473	5471	5469	5467	5464	5462	5460	5458
0.98	0.5456	5454	5452	5450	5448	5446	5444	5442	5440	5438
0.99	0.5436	5434	5432	5430	5428	5426	5424	5422	5420	5418
1.00	0.5416	5414	5412	5409	5407	5405	5403	5400	5398	5396
1.01	0.5394	5391	5389	5387	5385	5383	5380	5378	5376	5374
1.02	0.5371	5369	5367	5365	5362	5360	5358	5356	5354	5351
1.03	0.5349	5347	5345	5344	5340	5338	5336	5333	5331	5329
1.04	0.5327	5325	5322	5320	5318	5316	5313	5311	5309	5307
1.05	0.5305	5302	5300	5298	5296	5293	5291	5289	5287	5284
1.06	0.5252	5280	5278	5276	5273	5271	5269	5267	5264	5262
1.07	0.5260	5258	5255	5253	5251	5249	5247	5244	5242	5240
1.08	0.5238	5235	5233	5231	5229	5229	5224	5222	5219	5217
1.09	0.5215	5213	5211	5209	5206	5204	5202	5200	5197	5195
1.10	0.5193	5190	5188	5185	5183	5180	5178	5175	5173	5170
1.11	0.5168	5165	5163	5160	5158	5155	5153	5150	5148	5145
1.12	0.5143	5140	5137	5135	5132	5130	5127	5125	5122	5120
1.13	0.5118	5115	5113	5110	5108	5105	5103	5100	5098	5095
1.14	0.5093	5090	5088	5085	5083	5080	5078	5075	5073	5070

Chart for use with the Slope method (contd.)

μ	0	1	2	3	4	5	6	7	8	9
1.15	0.5068	5065	5062	5060	5057	5055	5052	5050	5047	5045
1.16	0.5042	5040	5037	5035	5032	5030	5027	5025	5022	5020
1.17	0.5017	5015	5012	5010	5007	5005	5002	5000	4997	4995
1.18	0.4992	4990	4987	4985	4982	4980	4977	4975	4972	4970
1.19	0.4967	4965	4962	4960	4957	4955	4952	4950	4947	4945
1.20	0.4942	4939	4936	4933	4930	4928	4925	4922	4919	4916
1.21	0.4913	4910	4907	4904	4901	4899	4896	4893	4890	4887
1.22	0.4884	4881	4878	4875	4872	4870	4867	4864	4861	4858
1.23	0.4855	4852	4849	4846	4843	4841	4838	4835	4832	4829
1.24	0.4826	4823	4820	4817	4814	4812	4809	4806	4803	4800
1.25	0.4797	4794	4791	4788	4785	4783	4780	4777	4774	4771
1.26	0.4768	4765	4762	4759	4756	4754	4751	4748	4745	4742
1.27	0.4739	4736	4733	4730	4727	4725	4722	4719	4716	4713
1.28	0.4710	4707	4704	4701	4698	4696	4693	4690	4687	4684
1.29	0.4681	4678	4675	4672	4669	4667	4664	4661	4658	4655
1.30	0.4652	4649	4645	4642	4638	4635	4631	4628	4625	4621
1.31	0.4618	4614	4611	4607	4604	4601	4597	4594	4590	4586
1.32	0.4583	4580	4577	4573	4570	4566	4563	4559	4556	4553
1.33	0.4549	4546	4542	4539	4535	4532	4529	4525	4522	4518
1.34	0.4515	4511	4508	4505	4501	4498	4494	4491	4487	4484
1.35	0.4481	4477	4474	4470	4467	4463	4460	4457	4453	4450
1.36	0.4446	4443	4439	4436	4432	4429	4426	4422	4419	4415
1.37	0.4412	4408	4405	4402	4398	4395	4391	4388	4384	4381
1.38	0.4378	4374	4371	4367	4364	4360	4357	4354	4350	4347
1.39	0.4343	4340	4336	4333	4330	4326	4323	4319	4316	4312

μ	0
1.40	0.430
1.41	0.426
1.42	0.422
1.43	0.418
1.44	0.414
1.45	0.409
1.46	0.405
1.47	0.401
1.48	0.397
1.49	0.393
1.50	0.388
1.51	0.384
1.52	0.379
1.53	0.374
1.54	0.368
1.55	0.363
1.56	0.358
1.57	0.352
1.58	0.346
1.59	0.340

8	9
047	5045
022	5020
997	4995
972	4970
947	4945
919	4916
890	4887
861	4858
832	4829
803	4800
.774	4771
1745	4742
.716	4713
1687	4684
1658	4655
1625	4621
1590	4586
1556	4553
1522	4518
1487	4484
1453	4450
1419	4415
1384	4381
1350	4347
1316	4312

μ	0	1	2	3	4	5	6	7	8	9
1.40	0.4309	4305	4301	4296	4292	4288	4284	4280	4275	4271
1.41	0.4267	4263	4258	4254	4250	4246	4242	4237	4233	4229
1.42	0.4225	4221	4216	4212	4208	4204	4200	4195	4191	4187
1.43	0.4183	4178	4174	4170	4166	4162	4157	4153	4149	4145
1.44	0.4141	4136	4132	4128	4124	4120	4115	4111	4107	4103
1.45	0.4099	4094	4090	4086	4082	4077	4073	4069	4065	4061
1.46	0.4056	4052	4048	4044	4040	4035	4031	4027	4023	4018
1.47	0.4014	4010	4005	4001	3997	3993	3989	3985	3980	3976
1.48	0.3972	3968	3964	3959	3955	3951	3947	3943	3938	3934
1.49	0.3930	3926	3921	3917	3913	3909	3905	3900	3896	3892
1.50	0.3888	3883	3878	3874	3869	3864	3859	3854	3850	3845
1.51	0.3840	3835	3830	3825	3820	3816	3811	3806	3801	3796
1.52	0.3791	3786	3781	3776	3771	3766	3760	3755	3750	3745
1.53	0.3740	3735	3730	3724	3719	3714	3709	3704	3698	3693
1.54	0.3688	3683	3677	3672	3667	3662	3656	3651	3646	3640
1.55	0.3635	3630	3624	3619	3613	3608	3602	3597	3591	3586
1.56	0.3580	3574	3569	3563	3557	3552	3546	3540	3534	3528
1.57	0.3523	3517	3511	3506	3500	3494	3488	3482	3477	3471
1.58	0.3465	3459	3453	3447	3441	3435	3429	3423	3417	3411
1.59	0.3405	3399	3393	3386	3380	3374	3368	3362	3355	3349

METHOD WHEN "DEAD" EARTH IS AVAILABLE

The techniques using test spikes explained earlier are the preferred methods of earth testing. In congested areas it may not be possible to find suitable sites for the test spikes, nor sufficient space to run the test leads. In these cases an alternative low resistance earth such as a water main may be available. This is referred to as a "dead" earth.

This must be of very low resistance to earth and connections are as shown in Fig. 17 with the 'C1-P1' ('E-ES') button in the depressed position. This test will give the combined resistance of the two earths in series. If that of the "dead" earth is negligible then the reading may be taken as that of the electrode under test.

However, great care must be taken before deciding to adopt this method and its use is not to be encouraged. This is because non-metallic piping and jointing materials are commonly found in water main and other installations nowadays and such materials are totally unsuitable as a substitute earth spike. Before employing this method, the user must be quite sure that no part of the "dead" earth installation contains plastic or other non-metallic materials.

The Star-Delta method is therefore preferable for use in congested urban areas and it is explained (along with the other methods referred to here) in the book

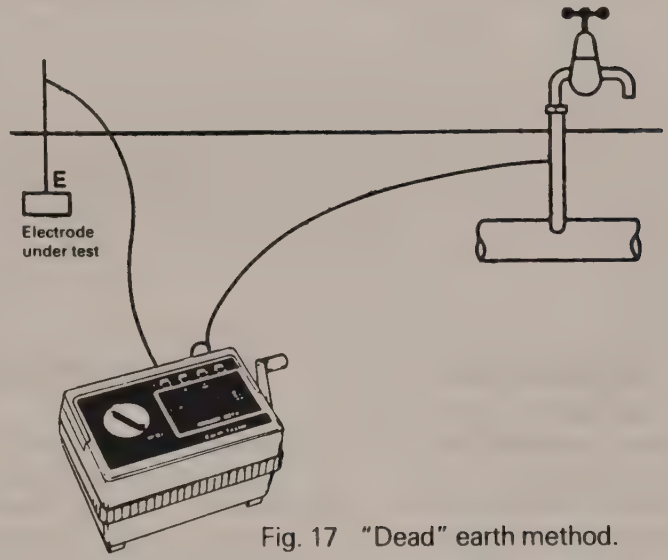

Fig. 17 "Dead" earth method.

"A Simple Guide to Earth Testing" published by MEGGER INSTRUMENTS LIMITED.

If only two test leads are used as shown in the diagram, the resistance of both leads will be included in the measurement. The resistance of the leads can be found by joining their ends together, operating the instrument and taking the reading in the usual way. This value should be subtracted from the total to obtain the combined resistance of the earth electrode and the "dead" earth.

15th EDITION IEE W
REQUIREMENT

Regulation 613-4 of
Regulations specifie
electrodes must be
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average of them is t
electrode. If there is
spike must be move
and the tests repeat

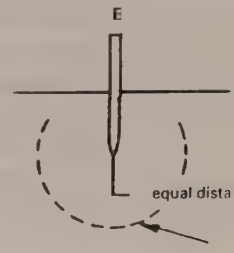
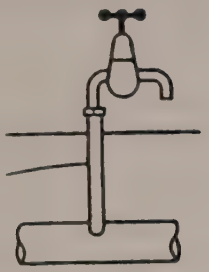


Fig. 18 Test spike p
IEE Wiring



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15th EDITION IEE WIRING REGULATIONS REQUIREMENT

Regulation 613-4 of the 15th Edition IEE Wiring Regulations specifies that the resistance of earth electrodes must be measured and the method to be used is described in Appendix 15 Item 4. This is basically the Fall-of-Potential method, but specifies that the potential spike must be moved 6 metres either side of the central position for the second and third resistance measurements (see Fig. 18). If the three results are in substantial agreement, the average of them is taken as the resistance of the earth electrode. If there is no agreement then the current spike must be moved farther away from the electrode and the tests repeated.

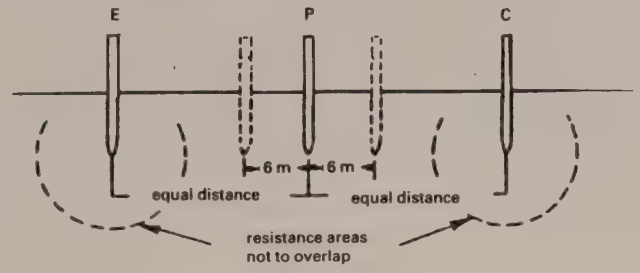

Fig. 18 Test spike positions for the 15th Edition IEE Wiring Regulations.

OTHER METHODS

There are other earth electrode resistance testing methods among which are the Four Potential method, the Intersecting Curves method and the Star-Delta method which is suitable for congested urban areas.

MEGGER INSTRUMENTS LIMITED have produced a book entitled "A Simple Guide to Earth Testing" which explains all these test methods and gives other helpful information about earth testing. It is available from the instrument manufacturer or one of his approved distributors and has the part no. 6171-230.

TOUCH POTENTIAL

Touch potential is the potential difference a person would experience across his body if he were, for example, standing on the ground outside the earthed perimeter fence of a substation and touching the fence at the time a fault to earth occurred.

Connect the instrument in the following way:—
Terminal 'C1' (or 'E') to the substation earth.
Terminal 'C2' (or 'H') to the current spike inserted in the ground some distance away.
Terminal 'P1' (or 'ES') to the structure being tested e.g. the perimeter fence.
Terminal 'P2' (or 'S') to a potential spike inserted in the ground 1 metre away from the perimeter fence adjacent to the point where a person might stand.

Operate the instrument and record the resistance indicated. This is the effective resistance between the point of test on the fence and the potential spike as seen by the test current.

The maximum value of the current that would flow in the earth when a fault to earth occurred at the substation must be known. The maximum fault current has to be calculated from the parameters associated with the substation ratings involved. From Ohm's Law (V = I x R), the Touch potential can be calculated.

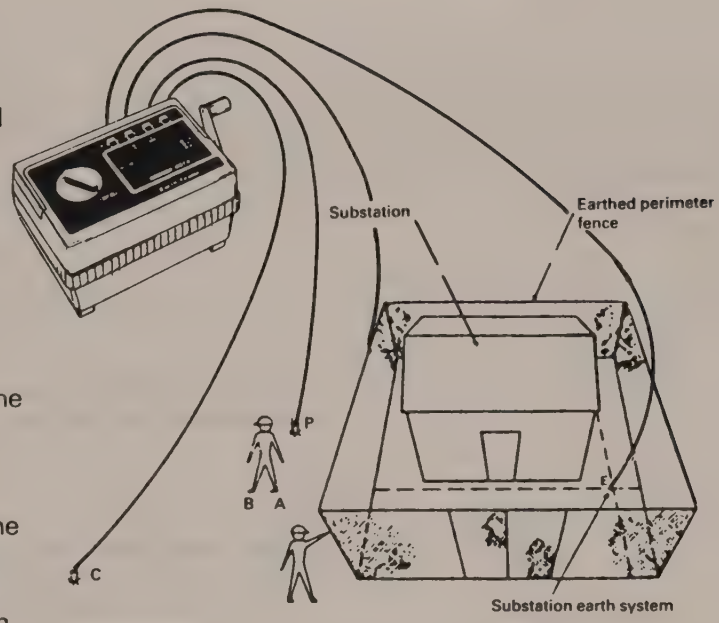

Fig. 19 Determining 'Touch' and 'Step' potential.

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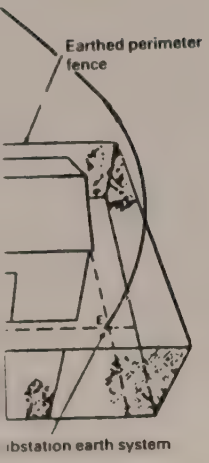

Step' potential.

STEP POTENTIAL

Step potential is the potential difference a person would experience between his feet as he walked across the ground in which a fault current was flowing.

Connect the 'C1' and 'C2' (or 'E' and 'H') terminals as described for touch potential measurement above. Connect the 'P1' and 'P2' terminals to test spikes inserted in the ground at positions A and B respectively, (see Fig. 19); A is nearest to the substation earth. Positions A and B are 1 metre apart, or the length of a step.

Operate the instrument and record the resistance indicated. This is the effective resistance across the positions A and B, as seen by the test current.

The maximum value of the current that would flow in the earth when a fault to earth occurred at the substation must be known (as is the case with Touch potential). From Ohm's Law (V = I x R), the Step potential can be calculated.

TYPICAL VARIATIONS IN SOIL RESISTIVITY

The resistance to earth of an earth electrode is influenced by the resistivity of the surrounding soil. The resistivity depends upon the nature of the soil and its moisture content and can vary enormously as seen in the table below:—

Material	Specific resistance in ohm-cms	Source of information
Ashes	350	Higgs
Coke	20-800	—
Peat	4,500-20,000	—
Garden earth – 50% moisture	1,400	Ruppel
" " – 20% moisture	4,800	"
Clay soil – 40% moisture	770	"
" " – 20% moisture	3,300	—
London clay	400-2,000	—
Very dry clay	5,000-15,000	—
Sand – 90% moisture	13,000	Ruppel
" – normal moisture	300,000-800,000	—
Chalk	5,000-15,000	—
Consolidated sedimentary rocks	1,000-50,000	Broughton Edge & Laby

Because it is impossible to forecast the resistivity of the soil with any degree of accuracy it is important to measure the resistance of an earth electrode when it is first laid down and thereafter at periodic intervals. Before sinking an electrode into the ground for a new installation it is often advantageous to make a preliminary survey of the soil resistivity of the surrounding site. This will enable decisions to be made on the best position for the electrode(s) and to decide whether any advantage is to be gained by driving rods to a greater depth. Such a survey may produce considerable savings in electrode and installation costs incurred trying to achieve a required resistance.

LINE TRAVERSE

The most common method of measuring soil resistivity is often referred to as the line traverse. Four test spikes are driven into the ground in a stright line at equal distances 'a' and to a depth of not more than 1/20 of 'a'. The instrument is connected to the test spikes as shown in Fig. 20.

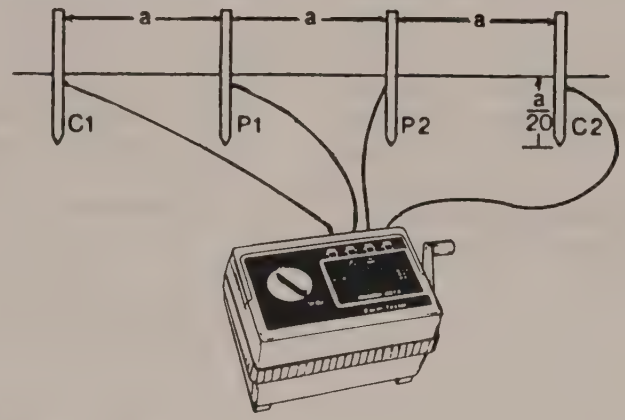

Fig. 20 Connections for resistivity testing.

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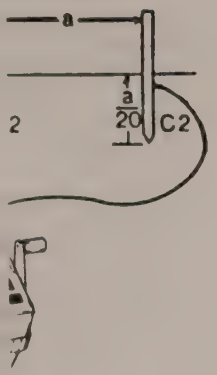

esistivity testing.

The instrument is operated and the measurement made in the normal way. The resistivity may be calculated from the formula given opposite or from the nomogram shown in Fig. 21 on page 50. This is the average soil resistivity to a depth 'a'.

The four test spikes are then re-positioned for further tests along a different line. If both the spacing 'a' and the depth '1/20 a' are maintained, a directly comparable reading will be obtained each time, and thus regions of lowest resistivity can be located over a given area (at the constant depth 'a').

Re-spacing the test spikes at separations 'b', 'c', 'd', etc. will yield results from which a profile of the resistivity at new depths '1/20 b', '1/20 c', '1/20 d', etc. can be obtained.

If the same line for the test spikes is maintained, but the separation of them is progressively widened resistivity values at various depths can be obtained. By this means depth surveys may be made. MEGGER INSTRUMENTS LIMITED, publication "A Simple Guide to Earth Testing" gives more information about the line traverse and depth surveys.

CALCULATION OF RESISTIVITY

Assuming that the soil in which the tests were made is homogeneous the resistivity is given by the formula:—

$$\rho = 2\pi aR$$

where R is the resistance measured in ohms, a is the test spike spacing in metres and ρ is the resistivity in ohm-metres.

For non-homogeneous soils the formula will give an apparent resistivity which is very approximately the average value to a depth equal to the test spike spacing 'a'.

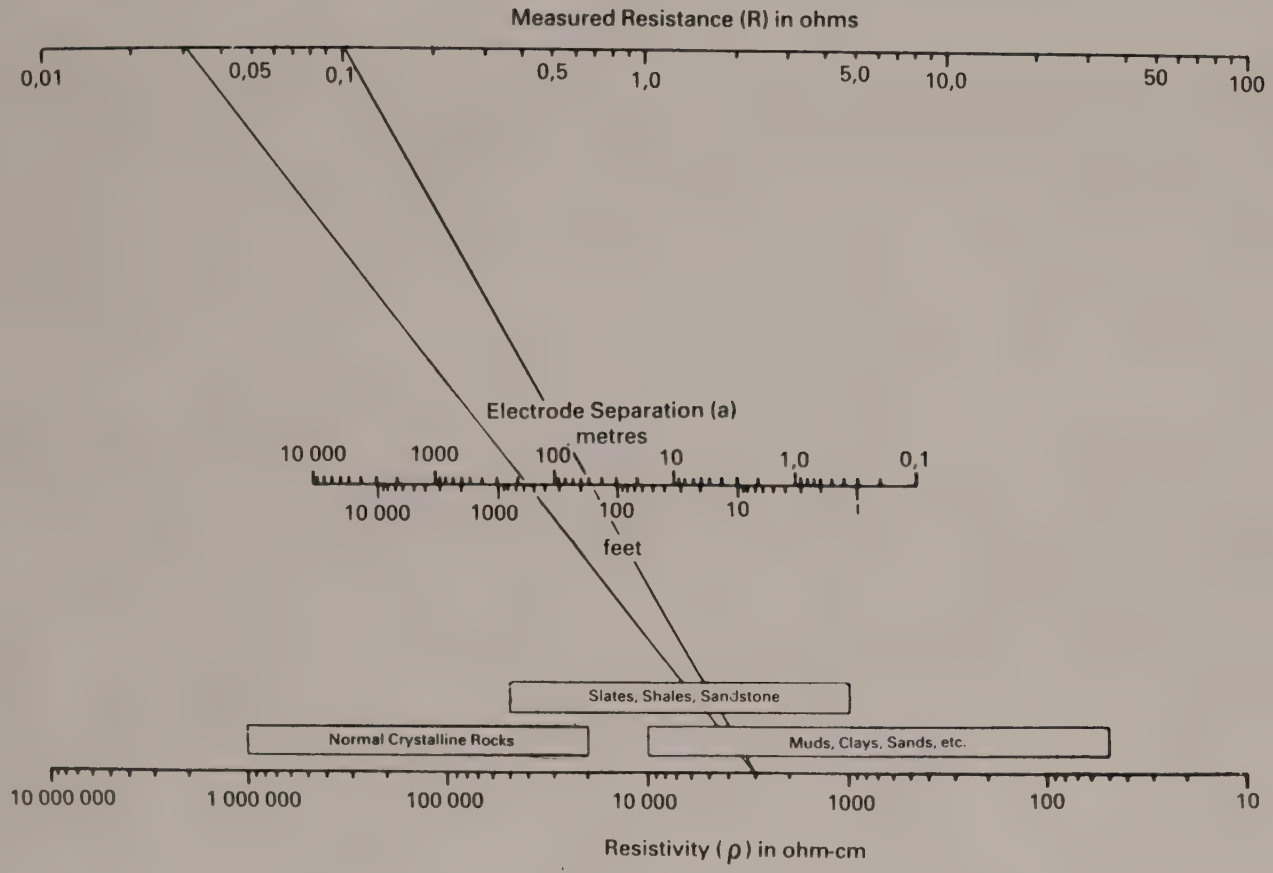

Fig. 21 Nomogram for resistivity calculations.

MEASURING TECHNIQUES Continuity Testing

To test the continuity of conduit or other earth conductors the instrument is connected as shown in Fig. 22. It will measure metallic resistances of low inductance or capacitance. Make sure that the circuit is 'dead' i.e. de-energized, before connecting the instrument for measurement.

Due to the inherent high accuracy of the instrument and the low continuity resistance to be measured, the contact resistance between the test lead clips and the conduit becomes a factor in the measured value. Contact resistance should therefore be kept as low as possible.

The resistance of the test leads may be found by connecting them to the 'P1' and 'P2' (or 'ES' and 'S') terminals and joining their free ends together. 'C1' and 'P1', and 'C2' and 'P2' (or 'E' and 'ES', and 'S' and 'H'), must be joined together before the measurement is made in the normal way. The test lead resistance is subtracted from the original reading to give the value of the continuity resistance. Alternatively use of the four terminal technique will eliminate the test lead resistance.

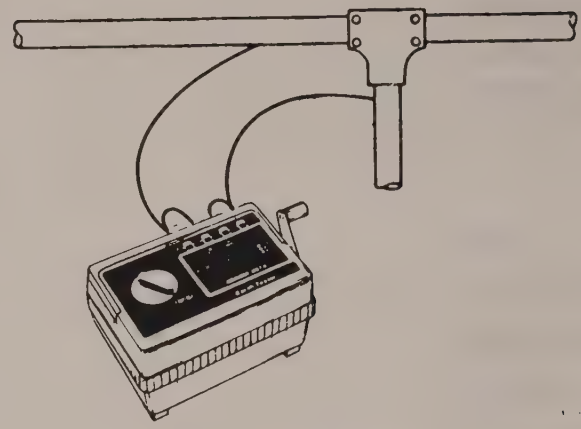

Fig. 22 Continuity testing.

The instrument employs the four terminal measurement principle, and so the potential drop across the earth resistance under test is fed to the measuring circuit via terminals 'P1' and 'P2' (or 'ES' and 'S'). An input buffer stage prevents the measuring circuit from loading the earth resistance being tested.

The test signal controls a constant current a.c. source powered from a 'floating' supply and switched to provide the three ranges. The test current is passed via the 'C1' and 'C2' (or 'E' and 'H') terminals through the earth under test.

A crystal controlled oscillator is at the heart of the waveform generator circuit. The fundamental frequency so derived is then sub-divided to provide a test signal of 128 Hz. Waveforms are also generated to operate the phase sensitive filter and detector circuits.

To remove noise imposed on the test signal as it passes through the earth under test, a phase sensitive filter is employed. The measurement signal is shown on the display directly in the units of ohms.

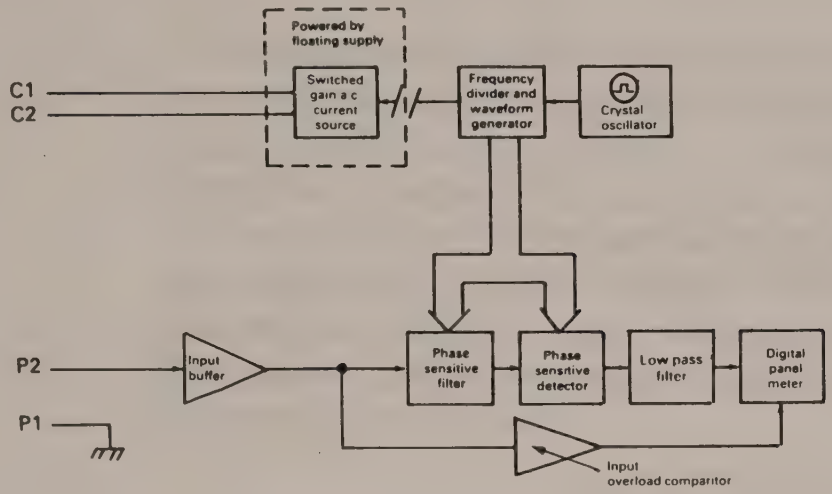

Fig. 23 Block diagram of instrument circuit.

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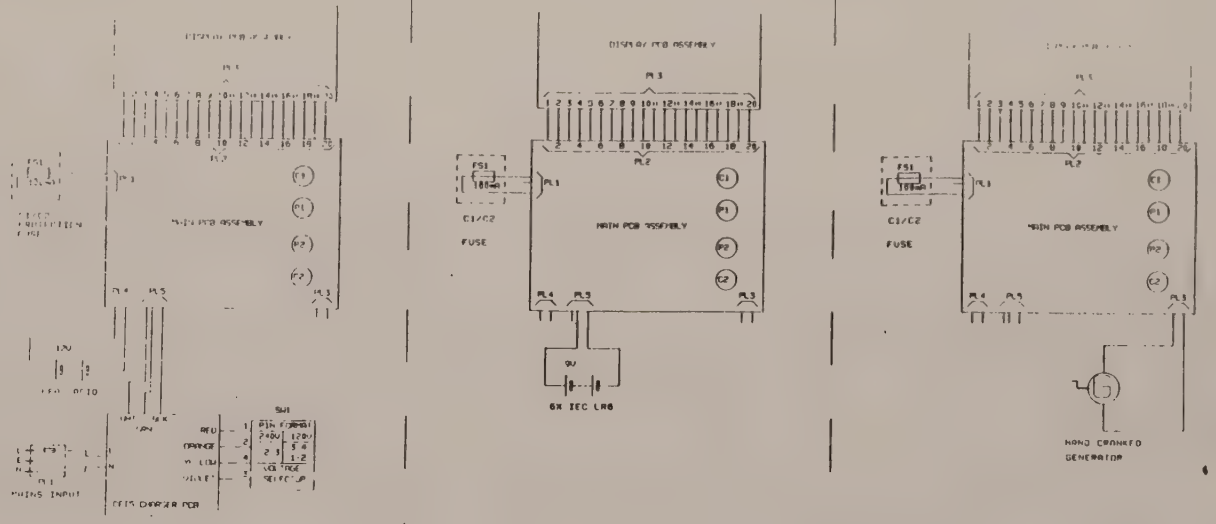
WARRANTY

Products supplied by Biddle Instruments are warranted against defects in material and workmanship for a period of one year following shipment. Our liability is specifically limited to replacing or repairing, at our option, defective equipment. Equipment returned to the factory for repair *must* be shipped prepaid and insured. This warranty does not include batteries, lamps, or other expendable items, where the original manufacturer's warranty shall apply. We make no other warranty. The warranty is void in the event of abuse (failure to follow recommended operating procedures) or failure by the customer to perform specified maintenance as indicated in this manual.

REPAIRS

Biddle Instruments maintains a complete instrument repair service, and recommends that its customers take advantage of this service in the event of equipment malfunction. Please indicate all pertinent information including problem symptoms and attempted repairs. When returning equipment for repair, either in or out of warranty, it *must* be shipped prepaid and insured, and marked for the attention of the Repair Department.



DET5/2

DET5/2E

DET5/2D

DET3/2

MAIN SCHEMATIC DIAGRAMS

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CR No	11659	11510	11533	11671	11818	11950	LW78

This is a Component Drawing The Tolerances shown refer to the Component and not its Associated Tooling

Third Angle Projection

DO NOT SCALE

Dimensions in Millimetres
Tolerances Unless Otherwise Stated
Decimal Dimensions ± 0.5
Dimensions to 1 Decimal Place ± 0.1
Angular Dimensions ± 1°
Holes to BS4500 Grade All

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Date 12/5/91
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Material
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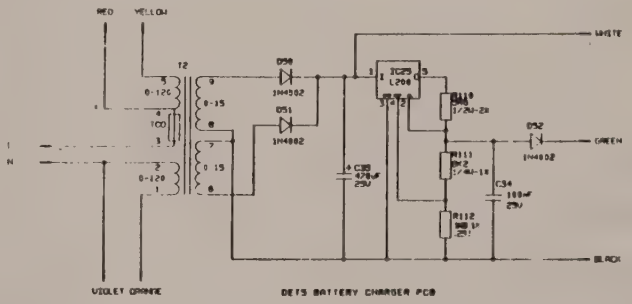
MEGGER INSTRUMENTS LTD

Title CIRCUIT DIAGRAM

Part No 6470-[illegible]

THE ABOVE CIRCUIT DIAGRAM RELATES TO MAIN PCB ASSY 6410-366-707-508 etc



DET5 BATTERY CHARGER PCB

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Dimensions in Millimetres
Tolerance Unless Otherwise Stated
Decimal Dimensions ± 0.5
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Scale N.T.S
Sht 4 of 4 Shts

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MEGGER INSTRUMENTS

Title
CIRCUIT DIAGRAM

Type No DET 3/5Mk2

Part No 6470-129

IF IN DOUBT ASK!

SPECIFICATION

Earth Resistance Ranges	0,01 Ω to 19,99 Ω 0,1 Ω to 199,9 Ω 1,0 Ω to 1,999 kΩ 10 Ω to 19,99 kΩ
Accuracy (23 °C ± 2 °C)	±2% of reading ±3 digits Total service error ±5% of reading ±3 digits.
Comply With Standards	BS CP1013 (1965) VDE 0413 Part 7 (1982)
Test Frequency	128 Hz ±0,5 Hz
Test Current	20 Ω range 10 mA a.c. r.m.s. 200 Ω range 1 mA a.c. r.m.s. 2 kΩ and 20 kΩ ranges 100 μA a.c. r.m.s. Test current (= short circuit current) is constant throughout the range.
Interference	Interference voltages of 20 V ± 1,0 V pk to pk 50 Hz in the potential circuit will have a max. effect of ± 1% on the reading obtained for the 20 Ω to 2 kΩ ranges. For the 20 kΩ range this interference voltage is reduced to 16 V ± 1,0 V pk to pk at f.s.d.
Max. Current Spike Resistance	The spike resistance that will introduce an additional 1% error is:— 20 Ω range 4 kΩ ±0,5 kΩ 200 Ω range 25 kΩ ±3 kΩ 2 kΩ and 20 kΩ ranges 50 kΩ ±5 kΩ (These are loop resistances, therefore the resistance under test must be subtracted from these figures).

Max. Potential Spike Resistance		The spike resistance that will introduce an additional 1% error is:— 20 Ω range 10 kΩ ±1 kΩ 200 Ω range 25 kΩ ±3 kΩ 2 kΩ and 20 kΩ ranges 100 kΩ ±10 kΩ (These are loop resistances, therefore the resistance under test must be subtracted from these figures).
Max. Output Voltage		50 V
Display		3½ digit l.c.d. maximum reading 1999
Temperature Effect		< ±0,02%/°C over the temperature range −15 °C to +55 °C
Temperature Range	operating storage	−15 °C to +55 °C (0 °C to +55 °C for the DET5/2D) −40 °C to +70 °C (for the DET5/2D, without batteries)
Humidity	operating storage	95% RH max. at 40 °C 93% RH max. at 55 °C
Flash Test Voltage Withstand		3 kV a.c. In the event of a system fault the instrument will withstand 240 V a.c. applied between any two terminals.
Fuses	DET3/2, DET5/2 and DET5/2D	100 mA ceramic HBC 20 mm x 5 mm IEC 127/1 (for current source protection) Internal 100 mA ceramic HBC 20 mm x 5 mm IEC 127/1 (for potential circuit protection) Internal 100 mA ceramic HBC 20 mm x 5 mm IEC127/1 (for 3/4 terminal switch circuit protection)

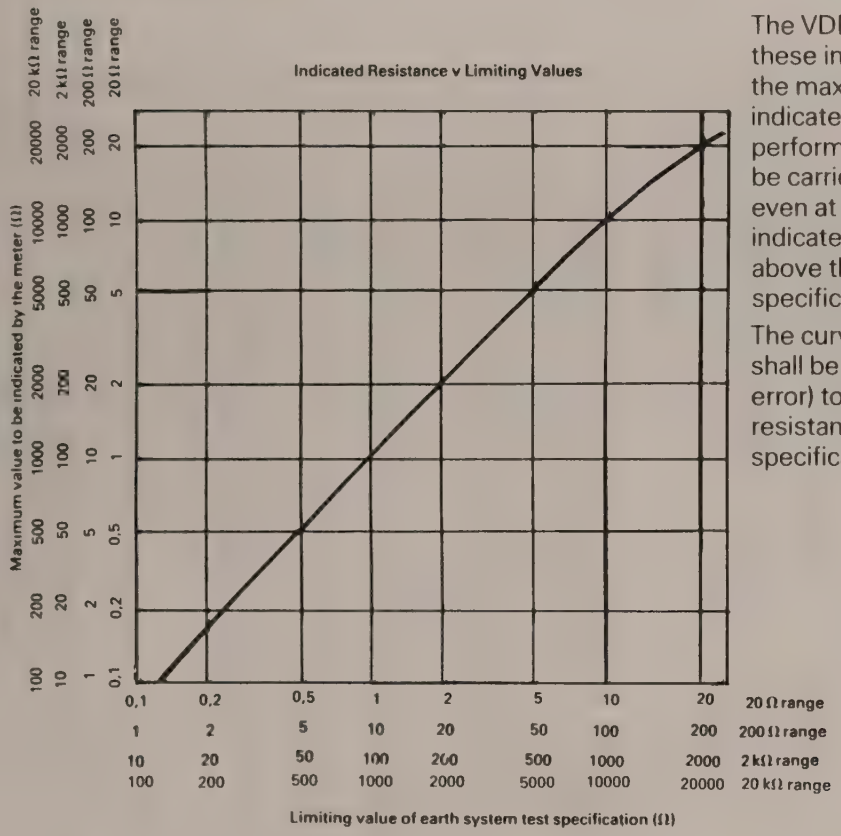
Power Su

Safety

Dimension

Weight

	DET5/2 only	50 mA ceramic HBC 20 mm x 5 mm IEC 127/1 for 240 V a.c. supply, 100 mA ceramic HBC 20 mm x 5 mm IEC 127/1 for 120 V a.c. supply (for circuit protection during battery charging). Internal 1 A ceramic HBC 20 mm x 5 mm IEC 127/1 (for battery protection)
Power Supply	DET3/2	Internal hand-cranked a.c. generator (Minimum cranking speed 120 r.p.m.)
	DET5/2	Internal rechargeable sealed lead acid cells 12 V, 0,8 Ah capacity. Battery voltage range over which basic accuracy is maintained, 10,0 V to 13,5 V. Battery life, 80 x 3 min tests (4 hours' continuous use). Battery charging time, 10 hours max. (from completely exhausted). Charging supply required, 200 V to 255 V a.c. or 100 V to 130 V a.c. 50 Hz/60 Hz.
	DET5/2D	6 x 1,5 V alkaline battery cells IEC LR6 type. Battery voltage range over which basic accuracy is maintained, 6 V to 10 V. Battery life 50 x 3 min tests (2½ hours continuous use); at 0 °C, 15 x 3 min tests (45 minutes continuous use).
Safety		The instruments will, in general, meet the requirements of BS 4743, IEC 348 and VDE 0411 specifications.
	DET3/2 and DET5/2D	Safety Class III
	DET5/2	Safety Class III while operating, Safety Class II while battery charging.
Dimensions	DET3/2	210 mm x 128 mm x 125 mm (8¼ in x 5 in x 5 in approx.)
	DET5/2 and DET5/2D	180 mm x 128 mm x 125 mm (7 in x 5 in x 5 in approx.)
Weight	DET3/2	1 kg (2¼ lb approx.)
	DET5/2	1,4 kg (3 lb approx.)
	DET5/2D	0,82 kg (1¾ lb approx.)



The VDE 0413 part 7 specification stipulates that these instructions should contain a diagram showing the maximum value which the instrument must indicate in certain conditions. An earth test being performed on any electrode system would normally be carried out to a particular specification. Therefore, even at the instrument's worst accuracy, the reading indicated should be such that the actual value is never above the limiting value required by the particular specification in question.

The curve opposite shows the maximum value which shall be indicated by the instrument (at its maximum error) to ensure that the limiting value of the earth resistance given in the relevant earth electrode test specification is met.

Title	Part No
PRODUCTION TEST SPECIFICATION	6171-514
1st Used On DET3/2 DET5/2 DET5/2D - VARIANTS	Sheet 1 of 11

SECTION A : Final instrument assembly; Without test fixtures.
SECTION B : Final instrument assembly; With test fixtures. USE SECTION B WHEN DEDICATED TEST GEAR IS AVAILABLE.

SECTION A

1.0 Generator (Det 3/2 only).
2.0 Mechanical switch action.
3.0 20Ω Range.
4.0 200Ω Range.
5.0 2kΩ Range.
6.0 Interference test.
7.0 Noise > MAX. indication.
8.0 20kΩ Range.
9.0 Operation at maximum Rp + Rc.
10.0 Frequency test.
11.0 Auto shutoff test.
12.0 Charger (DET 5/2 only)
13.0 Low battery indicator test.
14.0 Final Assembly.
15.0 Soak charging (DET 5/2 only).

1.0 Generator (Det 3/2 only).
Check generator is smooth running.

2.0 Mechanical switch action.
Check mechanical action of range switch. Ensure rotation is free from obstruction or stiffness.

3.0 20Ω Range.

3.1 With 3 - 4 terminal switch set to 4 terminal position, check that the application of a short circuit to all four terminal results in a reading of 0.00 ± 1 Digit. R17 is to be adjusted to achieve this.

3.2 With 3 - 4 terminal switch set to 4 terminal position, connect a 19Ω (± 0.2%) resistor to the four instrument terminals in the normal 4 terminal configuration. Adjust R6 such that display indicates 19.00Ω (± 2 Digits)

3.3 With 3 - 4 terminal switch set to 4 terminal position, connect a 10Ω (± 0.2%) resistor to the four instrument terminals in the normal 4 terminal configuration. Display to indicates 9.80Ω to 10.20Ω

3.4 Repeat 3.3 but with P1 and P2 terminals reversed. Negative sign must now be present.

3.5 With 3 - 4 terminal switch set to 3 terminal position, connect a 10Ω (± 0.2%) resistor to three instrument terminals (C1 & P1 are now internally connected).
Display to indicates 9.80Ω to 10.20Ω

3.6 Rc > MAX. should not be present on display.

4.0 200Ω Range.

4.1 With 3 - 4 terminal switch set to 4 terminal position, check that the application of a short circuit to all four terminals results in a reading of:- 00.0 ± 1 Digit.

4.2 With 3 - 4 terminal switch set to 4 terminal position, connect a 190Ω (± 0.2%) resistor to the four instrument terminals in the normal 4 terminal configuration.
Display to indicates:- 187.0Ω to 193.0Ω.

4.3 With 3 - 4 terminal switch set to 4 terminal position, connect a 100Ω (± 0.2%) resistor to the four instrument terminals in the normal 4 terminal configuration.
Display to indicates:- 98.0Ω to 102.0Ω

4.4 Rc > MAX. should not be present on display.

5.0 2kΩ Range.

5.1 With 3 - 4 terminal switch set to 4 terminal position, check that the application of a short circuit to all four terminals results in a reading of:- 0.000 ± 1 Digit.

5.2 With 3 - 4 terminal switch set to 4 terminal position, connect a 1.9kΩ (± 0.2%) resistor to the four instrument terminals in the normal 4 terminal configuration.
Display to indicates:- 1.870Ω to 1.930Ω.

5.3 With 3 - 4 terminal switch set to 4 terminal position, connect a 1kΩ (± 0.2%) resistor to the four instrument terminals in the normal 4 terminal configuration.
Display to indicates :- 0. 980kΩ to 1.020kΩ

5.4 Rc > MAX. should not be present on display.

6.0 Interference test.

6.1 Introduction.
Interference will be specified as follows :-

The injection of a 50Hz sinusoidal interference voltage of
20V pk. to pk. (or 7.07V RMS) will yield a maximum additional error of 1% of reading.
The above levels of noise amplitude are nominal and subject to manufacturing tolerances. Practical values to be used for test purposes are :-
Low limit instruments 19V pk/pk (6.71rms)
Nominal instruments 20V pk/pk (7.07rms)
High limit instruments 23V pk/pk (8.13rms)

6.2 Testing.

Test to be performed on 2kΩ range using resistor in 5.2 above.
(i) Note reading on display prior to adding noise (ie value obtained from resistor only).
(ii) The injection of a 50Hz sinusoidal voltage of 19V pk to pk (6.71V RMS) will yield a maximum ± 19 digits change to reading obtained in (i).

7.0 Noise > MAX. indication.

The injection of a 50Hz sinusoidal voltage of 23V pk to pk (or 8.13V RMS) will cause the Noise > MAX indicator to show.

8.0 20kΩ Range.

8.1 With 3 - 4 terminal switch set to 4 terminal position.check that the application of a short circuit to all four terminal results in a reading of:- 0.00 ± 1 Digit.

8.2 With 3 - 4 terminal switch set to 4 terminal position.connect a 19kΩ (± 0.2%) resistor to the four instrument terminals in the normal 4 terminal configuration.
Display to indicates:- 18.80kΩ to 19.20kΩ.

8.3 With 3 - 4 terminal switch set to 4 terminal position.connect a 10kΩ (± 0.2%) resistor to the four instrument terminals in the normal 4 terminal configuration.
Display to indicates:- 9.80kΩ to 10.20kΩ

8.4 Rc > MAX. should not be present on display.

9.0 Operation at maximum Rp + Rc.
The network shown in figure (i) shall be connected to the instrument under test.

9.1 Select the 20Ω Range.
Network should be configured as follows :-

R1 = R2 = 1.8kΩ (± 2.0%)
R3 = R4 = 4.7kΩ (± 2.0%)
R5 = 19.0Ω (± 0.2%)
R6 = 1.0kΩ (± 2.0%)
R7 = 1.6kΩ (± 2.0%)

(i) With S1 closed (a-d)
With S2 closed
With S3 closed
Note reading on display.

(ii) With S1 open (a-d)
With S2 closed
With S3 closed
Note reading on display is within ± 19 digits of value obtained in (i).
Rc > MAX. indication may be present.
With Test Rp switch (on instrument under test) depressed, Rp > MAX. indication should not be present on display.

(iii) With S1 open (a-d)
With S2 open
With S3 closed
Rc > MAX indication should be on.

(iv) With S1 open (a-d)
With S2 closed
With S3 open
With Test Rp switch depressed Rp > MAX. indication should be on.

9.2 Select the 200Ω Range.
Network should be configured as follows :-

R1 = R2 = 11kΩ (± 2.0%)
R3 = R4 = 11kΩ (± 2.0%)
R5 = 190Ω (± 0.2%)
R6 = 8.2kΩ (± 2.0%)
R7 9.1kΩ (± 2.0%)

(i) With S1 closed (a-d)
With S2 closed
With S3 closed
Note reading on display.

(ii) With S1 open (a-d)
With S2 closed
With S3 closed
Note reading on display is within ± 19 digits of value obtained in (i). Rc > MAX. indication may be on.
With Test Rp switch depressed, Rp > MAX. indication should not be present on display.

(iii) With S1 open (a-d)
With S2 open
With S3 closed
Rc > MAX. indication should be on.

(iv) With S1 open (a-d)
With S2 closed
With S3 open
With Test Rp switch depressed, Rp > MAX. indication should present on display.

9.3 Select the 2kΩ Range.
Network should be configured as follows :-

R1 = R2 = 22kΩ (± 2.0%)
R3 = R4 = 47kΩ (± 2.0%)
R5 = 1.9kΩ (± 0.2%)
R6 = 20kΩ (± 2.0%)
R7 = 27kΩ (± 2.0%)

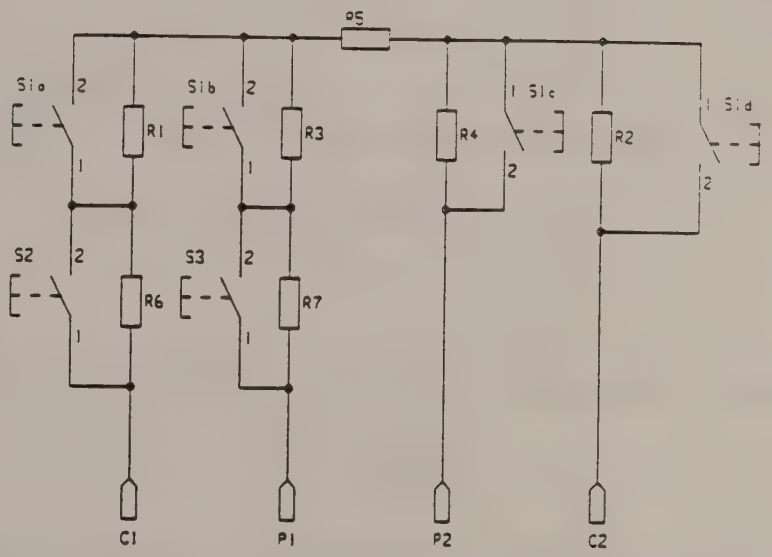
(i) With S1 closed (a-d)
With S2 closed
With S3 closed
Note reading on display.

(ii) With S1 open (a-d)
With S2 closed
With S3 closed
Note reading on display is within ± 19 digits of value obtained in (i). Rc > MAX. indicator may be on.
With Test Rp switch depressed, Rp > MAX. indication should be off.

(iii) With S1 open (a-d)
With S2 open
With S3 closed
Rc > MAX. indication should be on.

(iv) With S1 open (a-d)
With S2 closed
With S3 open
With Test Rp switch depressed,
Rp > MAX. indication should be on.

Figure (i).



10.0 Frequency test.

Reverting to the settings of 9.1(i).
Connect a frequency meter across terminals C1 and C2.
Check the frequency to the following limits- For USA : 135Hz ± 1 Hz.
All Others : 128Hz ± 1 Hz.

11.0 Auto shutoff test.

Note the instrument auto shutoff operates after 3 Minutes (± 1Min.) This can normally be checked after completing the above tests.

12.0 Charger (DET 5/2 etc. only).

12.1 Led indicator check.

With the voltage selector set to 240V position connect the instrument to mains. Observe that the LED indicator is on.

Charging current check.

i) Replace FS2 with 200mA Ammeter.
ii) Set instrument range switch to off.
iii) Note reading on ammeter is 70-90 mA.
NB. these figures may not be attainable with a charged battery in this case a dummy load must be connected in lieu of battery . ie 100Ω / 1W resistor.
iv) DET5/2 B MODELS ONLY:- Set voltage selector to 120V and connect to 120V supply. Check ammenter reading is 70 - 90mA as (iii).
v) Replace fuse FS2 .

Low battery indicator test.

DET 5/2 Models.

i) Remove battery connector (main PCB).
ii) Connect a variable dc. supply to battery connector PL4.
iii) By varying the output of dc. supply check operation of LOW BATTERY symbol (arrow on lhs of display) against the following table :-

Supply = 8.5V (± .25V) symbol ON.
Supply = 12.0V (± .25V) symbol OFF.

DET 5/2D Models.

i) Remove any batteries.
ii) Connect a variable dc. supply to battery clips.
iii) By varying the output of dc. supply check operation of LOW BATTERY symbol (arrow on lhs of display) against the following table :-

Supply = 5.00V (± .25V) symbol ON.
Supply = 7.0V (± .25V) symbol OFF.

Final Assembly.

Instrument can now be fully boxed. Care must be taken at this stage to ensure no wiring is trapped between PCBs and / or case parts.See Drawings; 6410-645 (DET3/2)
6410-647 (DET5/2)
6410-649 (DET5/2D)

Soak charging (DET 5/2 only).

All DET 5/2 models (and all rechargeable derivatives) are to be placed on 8 hour charge prior to final inspection. Instrument range switch to OFF position.

SECTION B

SECTION B TO BE USED WHEN DEDICATED TEST GEAR IS AVAILABLE.

1.0 Generator (Det 3/2 only).
2.0 Mechanical switch action.
3.0 20Ω Range.
4.0 200Ω Range.
5.0 2kΩ Range.
6.0 Interference test.
7.0 Noise > MAX. indication.
8.0 20kΩ Range.
9.0 Operation at maximum Rp + Rc.
10.0 Frequency test.
11.0 Autoshut off test.
12.0 Charger (DET 5/2 only)
13.0 Low battery indicator test.
14.0 Final Assembly.
15.0 Soak charging (DET 5/2 only).

1.0 Generator (Det 3/2 only).

Check generator is smooth running.

2.0 Mechanical switch action.

Check mechanical action of range switch. Ensure rotation is free from obstruction or stiffness.
Initial test gear settings:-

NOISE = OFF
P1/P2 = NORMAL
ZERO = ON
FUNCTION SWITCH = 19Ω

3.0 20Ω Range.

3.1 Select 20Ω Range on instrument on test.

3.2 3-4 terminal switch = 4 terminal mode
Display to indicate 0.00 ± 1 Digit. R17 is to be adjusted to achieve this.

3.3 Set test gear ZERO = OFF
Adjust R6 such that display indicates 19.00Ω (± 2 Digits).(ÑB Det3/2 rhs digit may be noisy).

3.4 Set test gear FUNCTION SWITCH = 10Ω .
Display to indicate 9.80 to 10.20 .

3.5 Set test gear P1/P2 = REVERSED.
Display to indicate -9.80 to -10.20 .

3.6 Rc > MAX. should not be present on display.

3.7 Set test gear P1/P2 = NORMAL

4.0 200Ω Range.

4.1 Select 200Ω Range on instrument on test.

4.2 3 - 4 terminal switch = 4 terminal mode
Test gear settings;
ZERO = ON.
FUNCTION SWITCH = 190Ω .
Display to indicate 00.0 ± 2 Digit.

4.3 Set test gear ZERO = OFF
Display to indicate 187.0Ω to 193.0Ω . (N.B. Det3/2 rhs digit may be noisy).

4.4 Set test gear FUNCTION SWITCH = 100Ω .
Display to indicate 98.0Ω to 102.0Ω .

4.5 Rc > MAX. should not be present on display.

5.0 2kΩ Range.

5.1 Select 2kΩ Range on instrument on test.

5.2 3-4 terminal switch = 4 terminal mode.
Test gear settings;
ZERO = ON.
FUNCTION SWITCH = 1.90kΩ .
Display to indicate .000 ± 2 Digit.

5.3 Set test gear ZERO = OFF
Display to indicate 1.870Ω to 1.930Ω . (N.B. Det3/2 rhs digit may be noisy).

5.4 Set test gear FUNCTION SWITCH = 1kΩ .
Display to indicate 0. 980kΩ to 1.020kΩ .

5.5 Rc > MAX. should not be present on display.

5.6 3-4 terminal switch = 3 terminal mode.
Display to indicate 0.980kΩ to 1.020kΩ .

5.7 3-4 terminal switch = 4 terminal mode.

6.0 Interference test.

6.1 Set test gear FUNCTION SWITCH = NOISE.
Note Display reading .

6.2 Set test gear NOISE = LOW.
Note Display reading differs by:- ± 19 digits from 6.1 (N.B. rhs digit may be noisy).

7.0 Noise > MAX. indication.

7.1 Set test gear NOISE = HIGH.
Note "Noise > Max" indicator is present.

7.2 Set test gear NOISE = OFF.

8.0 20kΩ Range.

8.1 Select 20kΩ Range on instrument on test

8.2 3-4 terminal switch = 4 terminal mode.
Test gear settings;
ZERO = ON.
FUNCTION SWITCH = 19kΩ .
Display to indicate 0.00 ± 2 Digit.

8.3 Set test gear ZERO = OFF
Display to indicate 18.70kΩ to 19.30kΩ . (N.B. Det3/2 rhs digit may be noisy).

8.4 Set test gear FUNCTION SWITCH = 10kΩ .
Display to indicate 9.80kΩ to 10.20kΩ .

8.5 Rc > MAX. should not be present on display.

9.0 Operation at maximum Rp + Rc.

9.11 Select 20Ω Range on instrument on test.

9.12 Test gear setting;-
FUNCTION SWITCH = ZERO RP/RC (yellow). Note reading on display.

9.13 FUNCTION SWITCH = RP/RC MAX (yellow).
Note reading on display is within ± 19 digits of value obtained in (9.12)
Rc > MAX. indication may be present on some units.

9.14 With Test Rp switch depressed, Rp > MAX. indication should not be present on display.

9.15 Test gear setting;-
FUNCTION SWITCH = RC > MAX. (yellow). Rc > MAX. indication should be present.

9.16 Test gear setting;-
FUNCTION SWITCH = RP > MAX. (yellow).
With Test Rp switch depressed, Rp > MAX. indication should be present on display.

9.21 Select 200Ω Range on instrument on test.

9.22 Test gear setting;-
FUNCTION SWITCH = ZERO RP/RC (orange). Note reading on display.

9.23 FUNCTION SWITCH = RP/RC MAX (orange).
Note reading on display is within ± 19 digits of value obtained in (9.22) Rc > MAX. indication may be present on some units.

9.24 With Test Rp switch depressed, Rp > MAX. indication should not be present on display.

9.25 Test gear setting;-
FUNCTION SWITCH = RC > MAX. (orange). Rc > MAX. indication should be present.

9.26 Test gear setting;-
FUNCTION SWITCH = RP > MAX. (orange).
With Test Rp switch depressed, Rp > MAX. indication should be present on display.

9.31 Select 2kΩ Range on instrument on test.

9.32 Test gear setting;-
FUNCTION SWITCH = ZERO RP/RC (red). Note reading on display.

9.33 FUNCTION SWITCH = RP/RC MAX (red).
Note reading on display is within ± 19 digits of value obtained in (9.32) Rc > MAX. indication may be present on some units.

9.34 With Test Rp switch depressed, Rp > MAX. indication should not be present on display.

9.35 Test gear setting;-
FUNCTION SWITCH = RC > MAX. (red). Rc > MAX. indication should be present.

9.36 Test gear setting;-
FUNCTION SWITCH = RP > MAX. (red).
With Test Rp switch depressed, Rp > MAX. indication should be present on display.

10.0 Frequency test.

Reverting to the settings of 9.32.
Connect a frequency meter across terminals C1 and C2.
Check the frequency to the following limits :- For USA : 135Hz ± 1 Hz.
All Others : 128Hz ± 1 Hz.

11.0 Auto shutoff test.

Note the instrument auto shutoff operates after 3 Minutes (± 1Min.) This can normally be checked after completing the above tests.

12.0 Charger (DET 5/2 & etc.).

12.1 Led indicator check.
With the instrument voltage selector set to 240V position, connect instrument to the mains. Observe LED indicator is on.

12.2 Charging current check.

(i) Replace FS2 with 200mA Ammeter.
(ii) Set instrument range switch to off.
(iii) Note reading on ammeter is 70-90 mA. NB. these figures may not be attainable with a charged battery in this case a dummy load must be connected in lieu of battery . ie 100Ω / 1W resistor.
(iv) DET5/2 B MODIELS ONLY:- Set voltage selector to 120V and connect to 120V supply. Check ammeter reading is 70 - 90mA as (iii).
(v) Replace fuse FS2 .

13.0 Low battery indicator test.

13.1 DET 5/2 Models.

(I) Remove battery connector (main PCB).
(ii) Connect a variable dc. supply to battery connector PL4.
(iii) By varying the output of dc. supply check operation of LOW BATTERY symbol (arrow on lhs of display) against the following table :-

Supply = 8.5V (± .25V) symbol ON.
Supply = 12.0V (± .25V) symbol OFF.

13.2 DET 5/2D Models.

(I) Remove any batteries.
(ii) Connect a variable dc.supply to battery clips.
(iii) By varying the output of dc supply check operation of LOW BATTERY symbol (arrow on lhs of display) against the following table :-

Supply = 5.00V (± .25V) symbol ON.
Supply = 7.0V (± .25V) symbol OFF.

14.0 Final Assembly.

Instrument can now be fully boxed. Care must be taken at this stage to ensure no wiring is trapped between PCBs and / or case parts. See Drawings;-

6410-645 (3/2)
6410-647(5/2)
6410-649(5/2D)

15.0 Soak charging (DET 5/2 etc. only).

All DET 5/2 models (and rechargeable derivatives) are to be placed on 8 hour charge prior to final inspection. Instrument range switch set to OFF.

MEGGER INSTRUMENTS LIMITED

ASSEMBLY PARTS LIST INDEX

FILE No. 695

PRODUCT DET 5/2 BIDDLE (250502)

SHEET 1 OF 1

	PART No.	DESCRIPTION	PART No.	DESCRIPTION
1	6410-653	STATION LIST (NO DRG)	6470-129	CIRCUIT DIAGRAM
2	6410-654	INSTRUMENT ASSY	6171-554	FINAL INSPECTION TEST SPEC
3	6430-567	MAIN PCB ASSY	6171-514	PRODUCTION TEST SPEC
4	6430-587	DISPLAY PCB ASSY	6171-515	TECHNICAL DESCRIPTION
5	6331-500	CHARGER PCB ASSY	6171-573	ATE/FUNCTIONAL PCB T/S
6	6331-501	CHARGER PCB SUB ASSY	6171-572	INVERTER TRANSFORMER T/S
7	6331-652	CASE REAR ASSY		
8	6131-870	TRANSFORMER ASSY		
9	6131-873	CONNECTOR ASSY (20WAY)		

MF 1

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ISS.	DATE	CN. No.
1	18/01/91	DIRN
2	15.2.91	11608
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DEV. REF | A | B | C | D | E | F | G | H | I | K | L |

CHANGES TO BE NOTIFIED TO:— (TICK)

- POST OFFICE
- P.D.S.
- BIDDLE
- NCB

MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	REQ'D FOR	A.C. No

26 [x] 28 31 33 42 44 58 60 66

START	STORE	TITLE	SHEET	ASSEMBLY No
COMPLETE		INSTRUMENT ASSY (SEE DRG 6410-647)	1 OF 3	6410-654 DET 5/2 BIDDLE

ITEM No.	DESCRIPTION (DATA TYPE 1 2)	PART No. 4—14	QTY PER ASSY.	UNIT 24—28	ISS. QTY 15—20	ACT. QTY 15—20
1	FRONT COVER MODIFIED	5210-354	1	EA		
2	SPRING DOWEL	21128-008	2	EA		
3	RANGE KNOB	5110-356	1	EA		
4	INDEX SPIDER	5410-082	1	EA		
5	PLASTITE SCREW N°4 x 3/8" PAN HD	21264-228	2	EA		
6	CARRYING HANDLE	5410-118	1	EA	-	
7	DISPLAY PCB ASSY	6430-587	1	EA	APL	
8	SPACING BOSS	5152-023	2	EA		
9	POLYMATE SCREW N°2 x 3/8" PAN HD	21264-234	2	EA		
10	PLASTITE SCREW N°4 x 1/4" PAN HD	21264-229	11	EA		
11	CASE REAR ASSY	6331-652	1	EA	APL	
12	BATTERY COVER	5410-125	1	EA		
13	FASTENER	21189-007	1	EA		
14	INSTRUCTION LABEL	5270-518	1	EA		
15	HOUSING BERG 1x4	25965-003	1	EA		
16	RECEPTACLE	25965-001	3	EA		
17	POLARIZING KEY	25965-004	1	EA		
18	WIRE 7/0.2 BLACK	13489-018	90	mm		

MF 1

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ISS.	DATE	CN. No.					
1	18/01/91	DIRN	5				
2			6				
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4			8				
			9				

CHANGES TO BE NOTIFIED TO:— (TICK)

POST OFFICE

P.O.S.

BIDDLE

MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	RECD FOR	A.C No.

26 28 31 33 42 44 66 68 80

START	STORE	TITLE	SHEET	ASSEMBLY No
COMPLETE		INSTRUMENT ASSY (SEE DRG 6410-647)	2 OF 3	6410-654 DET 5/2 BIDDLE

ITEM No.	DESCRIPTION (DATA TYPE 1 2)	PART No. 4—14	QTY PER ASSY.	UNIT 24—29	ISS. CTL 30—32	ACTL C 30—32
19	WIRE 7/0·2 GREEN	13489-017	90	mm		
20	WIRE 7/0·2 WHITE	13489-019	90	mm		
21	CHARGER PCB ASSY	6331-500	1	EA	APL	
22	TIE WRAP	25274-417	3	EA		
23	SEALING RING	5210-253	1	EA		
24	SWITCH ARM	5410-032	2	EA	-	
25	SPRING	5160-266	8	EA		
26	DUMMY CONTACT (PLASTIC)	5210-218	2	EA		
27	CONTACT	5230-343	6	EA		
28	MAIN PCB ASSY	6430-567	1	EA	APL	
29	CONTACT OIL	17613-523	A/R			
30	SHAFT EXTENSION	5210-252	1	EA		
31	CONNECTOR ASSY (20 WAY)	6131-873	1	EA	APL	
32	SLOT COVER	5110-426	1	EA		
33	WINDOW LABEL	5173-237	1	EA		
34	RANGE LABEL	5270-516	1	EA		
35	SERIAL Nº LABEL	5172-161	3	EA		
36	CAP HEAD SCREW M3 X 25 mm	21816-587	4	EA		

MF 1

ISS.	DATE	CN. No.	5		
1	18/01/91	DIRN	6		
2			7		
3			8		
4			9		

CHANGES TO BE NOTIFIED TO:— (TICK)

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P.D.S.	✓
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MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	RECD. FOR	A.C. No.

25 [x] 28 [ ] 31 33 [ ] 42 41 [ ] 56 58 [ ] 60

START	STORE	TITLE	SHEET	ASSEMBLY No.
COMPLETE		INSTRUMENT ASSY (SEE DRG 6410-647)	3 OF 3	6410-654 DET 5/2 BIDDLE

ITEM No.	DESCRIPTION	DATA TYPE 1 2 [ ]	PART No. 4—14	QTY PER ASSY.	UNIT 24—25	ISS. QTY 26—27	ADD. QTY 28—30
37	FOOT		22400-001	4	EA		
38	CABLE CLIP SELF ADHESIVE		25945-025	1	EA		
39	BEZEL (SHORT)		25975-018	2	EA		

ISS.	DATE	CN. No.	5			CHANGES TO BE NOTIFIED TO:— (TICK)	
1	18/01/91	DIRN	6				
2			7			POST OFFICE	
3			8			P.D.S.	2
4			9			BIDDLE	

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MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	RECD. FOR	A.C. No

26 28 31 33 42 44 56 58 63

START	STORE	TITLE	SHEET	ASSEMBLY No
COMPLETE		STATION LIST (NO DRG)	1 OF 1	6410-653 DET S/2 BIDDLE

ITEM No.	DESCRIPTION	DATA TYPE 1 2	PART No. 4—14	QTY PER ASSY.	UNIT 24—28	ISS. QTY. 18—22	ACTUAL QTY. 18—22
1	INSTRUMENT ASSY		6410-654	1	EA	APL	
2	TERMINAL POST ADAPTOR, RED		6320-207	2	EA		
3	TERMINAL POST ADAPTOR, BLACK		6320-206	2	EA		
4	CARTON LABEL OUTER		5172-355	1	EA		
5	PACKING PIECE		6460-043	1	EA		
6	PACKING BOX		6360-067	1	EA	-	

MF 1

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ISS.	DATE	CN. No.	5			9	
1	18/01/91	DIRN	6				
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3			8				
4			9				

CHANGES TO BE NOTIFIED TO:— (TICK)

POST OFFICE

P.D.S.

BIDDLE

MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	REQD. FOR	A.C. No.

25 28 31 33 42 44 56 58 63

START	STORE	TITLE	SHEET	ASSEMBLY No.
COMPLETE		INSTRUMENT ASSY (SEE DRG 6410-647)	1 OF 3	6110-966. DET 5/2 Mx 2210

ITEM No.	DESCRIPTION (DATA TYPE 1 2)	PART No. 4—14	QTY PER ASSY.	UNIT 24—25	ISS. QTY 26—27	ACT. QTY 28—29
1	FRONT COVER MODIFIED	5210-354	1	EA		
2	SPRING DOWEL	21128-008	2	EA		
3	RANGE KNOB	5110-356	1	EA		
4	INDEX SPIDER	5410-082	1	EA		
5	PLASTITE SCREW N°4 x 3/5" PAN HD	21264-228	2	EA		
6	CARRYING HANDLE	5410-118	1	EA		
7	DISPLAY PCB ASSY	6430-565	1	APL		
8	SPACING BOSS	5152-023	2	EA		
9	POLYMATE SCREW N°2 x 3/5" PAN HD	21264-234	2	EA		
10	PLASTITE SCREW N°4 x 1/4" PAN HD	21264-229	11	EA		
11	CASE REAR ASSY	6331-503	1	APL		
12	BATTERY COVER	5410-125	1	EA		
13	FASTENER	21159-007	1	EA		
14	INSTRUCTION LABEL	5270-547	1	EA		
15	HOUSING, BERG 1x4	25965-003	1	EA		
16	RECEPTACLE	25965-001	3	EA		
17	POLARIZING KEY	25965-004	1	EA		
18	WIRE 7/0.2 BLACK	13489-018	90	mm		

MF 1

ISS.	DATE	CN. No.	5		
1	11.7.91	PDR	6		
2			7		

CHANGES TO BE NOTIFIED TO:— (TICK)

POST OFFICE

MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	REQ'D FOR	A/C. No.

25 28 31 33 42 44 56 58 60

START	STORE	TITLE	SHEET	ASSEMBLY No.
COMPLETE		INSTRUMENT ASSY (SEE DRG 6410-647)	2 OF 3	6110-966
				DET 5/2 Mx4210

ITEM No.	DESCRIPTION	DATA TYPE 1 2	PART No. 4—14	QTY PER ASSY.	UNIT 24—25	ISS. QTY. 26—27	ISS. QTY. 28—29
19	WIRE 7/0·2 GREEN		13439-017	90	mm		
20	WIRE 7/0 2 WHITE		13439-019	90	mm		
21	CHARGER PCB ASSY		6331-500	1	APL		
22	TIE WRAP		25274-417	3	EA		
23	SEALING RING		5210-253	1	EA		
24	SWITCH ARM		5410-032	2	EA		
25	SPRING		5160-266	5	EA		
26	DUMMY CONTACT (PLASTIC)		5210-219	2	EA		
27	CONTACT		5230-343	6	EA		
28	MAIN PCB ASSY		6430-567	1	APL		
29	CONTACT OIL		17613-523	A/R			
30	SHAFT EXTENSION		5210-252	1	EA		
31	CONNECTOR ASSY (20 WAY)		6131-873	1	APL		
32	SLOT COVER		5110-426	1	EA		
33	WINDOW LABEL		5173-365	1	EA		
34	RANGE LABEL		5270-542	1	EA		
35	SERIAL Nº LABEL		5172-161	3	EA		
36	CAP HEAD SCREW M3 x 25 mm		21516-557	4	EA		

MF 1

ISS.	DATE	CN. No.	5			CHANGES TO BE NOTIFIED TO:— (TICK)
1	11.7.94	PDR	6			
2			7			POST OFFICE

MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	REQ'D. FOR	A/C. No.

25 28 31 33 42 44 56 58 60

START	STORE	TITLE	SHEET	ASSEMBLY No.
COMPLETE		INSTRUMENT ASSY (SEE DRG 6410-647)	3 OF 3	6110-966 DET 5/2 Mx 4210

ITEM No.	DESCRIPTION	DATA TYPE 1 2	PART No. 4—14	QTY PER ASSY.	UNIT 24—25	ISS. QTY 18—22	ACT. QTY 18—22
37	FOOT		22400-001	4	EA		
38	CABLE CLIP SELF ADHESIVE		25945-025	1	EA		
39	BEZEL (SHORT)		25975-018	2	EA		

MF 1

A4

ISS.	DATE	CN. No.	5			CHANGES TO BE NOTIFIED
1	11.7.91	PDR	6			TO:— (TICK)
2			7			POST OFFICE
3			8			P.O.'s

MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	REQ'D. FOR	A.C.No.

26 [T] 28 [ ][ ][ ] 31 33 [ ][ ][ ][ ][ ][ ][ ][ ] 42 44 [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ] 56 58 [ ][ ][ ][ ][ ][ ] 63

START	STORE	TITLE	SHEET	ASSEMBLY No
COMPLETE		DISPLAY PCB ASSY (135.3 Hz) (SEE DRG 6430-565)	1 OF 8	6430-587 DET 3/5/2 3 DD-E

ITEM No.	DESCRIPTION (DATA TYPE 1 2 [ ][ ])	PART No. 4—14	QTY PER ASSY.	UNIT 24—25	ISS. QTY	ACT QTY
1	DISPLAY PCB	5440-157	1	EA		
2	HARWIN PIN (22x9mm LONG)	25258-430	198	mm		
3	DISPLAY HOUSING	5410-141	1	EA		
4	L.C.D DISPLAY (4½ DIGIT)	25992-002	1	EA		
5	SUPPORT	5210-299	1	EA		
6	ZEBRA STRIP	6180-284	2	EA		
7	PLASTITE SCREW N°4 x ¼"	21264-229	2	EA		
8	KEY CAP 'RED'	25975-005	2	EA		
9	SWITCH SUPPORT	25975-006	1	EA		
S1	SWITCH MOMENTORY	25975-043	1	EA		
S2	SWITCH LATCHING	25975-042	1	EA		
PL1	NOT FITTED					
PL2	NOT FITTED					
PL3	SEE ITEM 2					
R1	RESISTOR 182K-1-0.25W	26900-103	1	EA		
R2	RESISTOR 8K2 -1-0.25W	26900-159	1	EA		
R3	RESISTOR 100K-1-0.25W	26900-097	12	EA		

MF 1

ISS.	DATE	CN. No.	5		
1	18/01/91	DIRN	6		
2	4.2.91	11574	7		
3			8		
4			9		

CHANGES TO BE NOTIFIED TO:— (TICK)

POST OFFICE [ ]
P.D.S. [ ]
BIDDLE [ ]

A4

MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	RECD FOR	A/C No.

25 [x] 28 [ ] 31 33 [ ] 42 44 [ ] 56 58 [ ] 60

START	STORE	TITLE	SHEET	ASSEMBLY No.
COMPLETE		DISPLAY PCB ASSY (135.3MHz) (SEE DRG 6430-565)	2 OF 8	6430-587 DET 3/5/2 3 DIGIT

ITEM No.	DESCRIPTION	DATA TYPE 1 2 [ ]	PART No. 4—14	QTY PER ASSY.	UNIT 24—25	ISS. QTY 26—27	ACT. QTY 28—29
R4	RESISTOR 475R-1-0·25W		26900-041	2	EA		
R5	RESISTOR 10K-1-0·25W		26900-073	3	EA		
R6	POTENTIOMETER 100R-20-CMPT		27889-937	1	EA		
R7	RESISTOR 1M-1-0·25W		26900-127	4	EA		
R8	RESISTOR 47K-1-0·25W		26900-137	1	EA		
R9	AS R3						
R10	AS R7						
R11	RESISTOR 130K-1-0·25W		26900-100	3	EA		
R12	AS R11						
R13	AS R3						
R14	AS R3						
R15	AS R3						
R16	POTENTIOMETER 50K-20-0·3CMPT		27889-966	1	EA		
R17	RESISTOR 240K-1-0·25W		26900-166	1	EA		
R18	AS R5						
R19	RESISTOR 90K-0·25-0·25W		26836-391	1	EA		
R20	RESISTOR 1K-1-0·25		26900-049	2	EA		
R21	AS R3						

MF 1

ISS.	DATE	CN. No.			
1	18/01/91	DIRN	5		
2			6		
3			7		
4			8		
			9		

CHANGES TO BE NOTIFIED TO:— (TICK)

POST OFFICE	
P.O.S.	/
BIDDLE	

A4
A1

MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	RECD. FOR	A/C. No

26 28 31 33 42 44 56 58 63

START	STORE	TITLE	SHEET	ASSEMBLY No
COMPLETE		DISPLAY PCB ASSY (135,3 Hz) (SEE DRG 6430-565)	3 OF 8	643C-587 DET 3/5/2 BIDDLE

ITEM No.	DESCRIPTION DATA TYPE 1 2	PART No. 4—14	QTY PER ASSY.	UNIT 24—25	ISS. QTY 18—23	ACT. QTY 8—23
R22	AS R3					
R23	RESISTOR 10K-0·25-0·25W	26836-375	1	EA		
R24	AS R3					
R25	RESISTOR 39K-1-0·25	26900-214	1	EA		
R26	AS R20					
R27	AS R 4					
R28	RESISTOR 2K21-1-0·25W	26900-057	1	EA		
R29	AS R7					
R30	RESISTOR 8K75-1-0·25W	26836-670	2	EA		
R31	AS R3					
R32	RESISTOR 30K1-1-0·25W	26900-084	1	EA		
R33	AS R30					
R34	AS R3					
R35	AS R7					
R36	AS R3					
R37	AS R11					
R38	RESISTOR 100R-1-0·25W	26900-025	2	EA		
R39	AS R3					

MF 1

ISS.	DATE	CN. No.	5			6			7			8			9		
1	18/01/91	DIRN															
2																	
3																	
4																	

CHANGES TO BE NOTIFIED TO:— (TICK)

POST OFFICE | | P.O.S. | | BIDDLE | |

A4

MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	REQ'D. FOR	A/C. No

26 28 31 33 42 44 56 58 63

START	STORE	TITLE	SHEET	ASSEMBLY No
COMPLETE		DISPLAY PCB ASSY (135.3 Hz) (SEE DRG 6430-565)	4 OF 8	6430-587 DET 3/5/2 B.00

ITEM No.	DESCRIPTION	DATA TYPE 1 2	PART No. 4—14	QTY PER ASSY.	UNIT 24—25	ISS. QTY. 18—22	ACT. QTY. 8—22
R40	RESISTOR 20K-1-0·25W		26900-080	3	EA		
R41	AS R40						
R42	RESISTOR 220K-2-0·5W		26836-169	1	EA		
R43	AS R40						
R44	AS R38						
R45	AS R5						
RN1	RESISTOR NETWORK 8x100K-5-N		26836-686	1	EA		
C1	CAPACITOR 47pF-63DC-CE		27889-006	2	EA		
C2	CAPACITOR 220nF-63DC-PE		27889-825	1	EA		
C3	CAPACITOR 470nF-50DC-PE		27889-868	2	EA		
C4	CAPACITOR 1μF-50DC-PE		27889-996	7	EA		
C5	CAPACITOR 100nF-63DC-PE		27889-827	1	EA		
C6	CAPACITOR 22μF-16DC-TA		27888-811	2	EA		
C7	AS C6						
C8	CAPACITOR 100nF-25DC-CE		27889-836	12	EA		
C9	AS C8						
C10	AS C4						

MF 1

A4

ISS.	DATE	CN. No.				
1	18/01/91	DIRN	5			
2			6			
3			7			
4			8			
			9			

CHANGES TO BE NOTIFIED TO:— (TICK)

POST OFFICE

P.D.S.

RIDDLE

MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	REQ'D FOR	A.C. No

25 [x] 28 31 33 42 44 56 58 63

START	STORE	TITLE	SHEET	ASSEMBLY No
COMPLETE		DISPLAY PCB ASSY (135.3Hz) (SEE DRG 6430-565)	5 OF 8	6430-587 DET 3/5/2 3 DOCE

ITEM No.	DESCRIPTION	DATA TYPE 1 2	PART No. 4—14	QTY PER ASSY.	UNIT 24—25	ISS. QTY 18—22	ACT. QTY 18—22
C11	CAPACITOR 10μF-16DC-E-A		27889-950	2	EA		
C12	AS C8						
C13	NOT USED						
C14	AS C4						
C15	AS C11						
C16	NOT USED						
C17	AS C4						
C18	CAPACITOR 15pF-63DC-CE		27889-491	1	EA		
C19	NOT USED						
C20	AS C8						
C21	AS C3						
C22	AS C8						
C23	AS C8						
C24	AS C8						
C25	AS C4						
C26	AS C4						
C27	AS C8						
C28	AS C8						

MF 1

A4

ISS.	DATE	CN. No.				
1	18/01/91	DIRN	5			
2			6			
3			7			
4			8			
			9			

CHANGES TO BE NOTIFIED TO:— (TICK)

POST OFFICE

P.D.S.

MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	RECD. FOR	A.C. No.

25 28 31 33 42 44 56 58 60

START	STORE	TITLE	SHEET	ASSEMBLY No.
COMPLETE		DISPLAY PCB ASSY (135.3 Hz) (SEE DRG 6430-565)	6 OF 8	6430-587 DET 3/5/2 BIDDLE

ITEM No.	DESCRIPTION	DATA TYPE 1 2	PART No. 4—14	QTY PER ASSY.	UNIT 24—25	ISS. QTY 18—20	ACT. QTY 18—20
C29	AS C4						
C30	AS C8						
C31	AS C8						
C32	AS C1						
C33	AS C8						
D1	BANDGAP DIODE D-ICL 8069		28863-268	2	EA		
D2	ZENER DIODE BZX 79 C5V6		28474-273	1	EA		
D3	DIODE D IN4148		28433-801	11	EA		
D4	LED 6mm Ø RED		28863-339	1	EA		
D5	AS D1						
D6	AS D3						
D7	AS D3						
D8	AS D3						
D9	AS D3						
D10	AS D3						
D11	AS D3						

MF 1

ISS.	DATE	CN. No.	5		
1	18/01/91	DIRN	6		
2			7		
3			8		
4			9		

CHANGES TO BE NOTIFIED TO:— (TICK)

POST OFFICE

P.D.S.

BIDDLE

A4

A4

MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	REQ'D FOR	A.C. No.

25 [X] 29 31 33 42 44 66 68 80

START	STORE	TITLE	SHEET	ASSEMBLY No.
COMPLETE		DISPLAY PCB ASSY (135/3 Hz) (SEE DRG 6430-565)	7 OF 8	6430-587 DET 3/5/2 BIPOLE

ITEM No.	DESCRIPTION	DATA TYPE 1 2	PART No. 4—14	QTY PER ASSY.	UNIT 24—25	ISS. QTY 8—22	ACT QTY 8—22
D12	ZENER DIODE BZX 79C15		28863-078	2	EA		
D13	AS D3						
D14	AS D3						
D15	AS D12						
D16	AS D3						
D17	AS D3						
XL1	CRYSTAL 4.43619 OR 4.43361875 MHz		28900-051	1	EA		
IC1	QUAD EXCLUSIVE OR GATE 4070		20000-070	2	EA		
IC2	A/D CONVERTER 7106 ICL		20000-106	1	EA		
IC3	AS IC1						
IC4	QUAD BILATERAL SWITCH 4066		20000-066	2	EA		
IC5	271 ACP-TLC		20000-471	1	EA		
IC6	14 STAGE COUNTER/OSCILLATOR 4060		20000-060	1	EA		
IC7	DUAL OP AMP 272M-TLC		20000-672	1	EA		

MF 1

ISS.	DATE	CN. No.	5		
1	18/01/91	DIRN	6		
2			7		
3			8		
4			9		

CHANGES TO BE NOTIFIED TO:— (TICK)

POST OFFICE

P.D.S.

A4

MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	REQ'D FOR	A.C. No.

26 [X] 28 31 33 42 44 56 58 60

START	STORE	TITLE	SHEET	ASSEMBLY No.
COMPLETE		DISPLAY PCB ASSY (135.3 Hz) (SEE DRG 6430-565)	8 OF 8	6430-587 DET 3/5/2 & CODE

ITEM No.	DESCRIPTION	DATA TYPE 1 2	PART No. 4—14	QTY PER ASSY.	UNIT 24—25	ISS. QTY 18—20	ACT. QTY 18—20
IC8	AS IC4						
IC9	DUAL D-TYPE FLIP FLOP 4013		20000-013	1	EA		
IC10	DUAL OP-AMP 272L-TLC		20000-004	1	EA		
IC11	QUAD 2 INPUT NAND GATE 4011		20000-011	1	EA		
IC12	QUAD ANALOGUE SWITCH 211A-DG		20000-211	1	EA		
IC13	BIFET OP AMP 061-TL		20000-061	1	EA		
TR1	TRANSISTOR TR-2N7000		20000-700	1	EA		

MF 1

ISS.	DATE	CN. No.			
1	18/01/91	DIRN	5		
2			6		
3			7		
4			8		
			9		

CHANGES TO BE NOTIFIED TO:— (TICK)

POST OFFICE	
P.D.S.	
BIDDLE	

A4

MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	RECD FOR	A.C. No.

START	STORE	TITLE	SHEET	ASSEMBLY No.
COMPLETE		MAIN PCB ASSY	1 OF 9	6430-507 DET 512

ITEM No.	DESCRIPTION	PART No. 4—14	QTY PER ASSY.	UNIT 24—25	ISS CT. 18—22	ACT. 15—22
1	PCB	5440-139	1	EA		
2	SOCKET 4mm	5151-843	4	EA		
3	HARWIN AUTOPIN (28 x 9mm LONG)	25258-430	252	mm		
4	FUSE CLIPS	2548-213	6	EA		
5	KAPTON DISC	10005-214	1	EA		
R1	RESISTOR 16K-5-3W	26836-937	1	EA		
R2	RESISTOR 47R-5-2·5W	26836-639	1	EA		
R3	RESISTOR 100K-1-0·25W	26900-097	15	EA		
R4	RESISTOR 130K-1-0·25W	26900-100	3	EA		
R5	RESISTOR 10K-1-0·25W	26900-073	5	EA		
R6	RESISTOR 2K-1-0·25W	26900-056	4	EA		
R7	RESISTOR 240K-1-0·25W	26900-166	1	EA		
R8	AS R5					
R9	WIRE LINK	25925-010	1	EA		
R10	RESISTOR 30K-1-0·25W	26900-211	4	EA		
R11	AS R10					

MF 1

A4

ISS.	DATE	CN. No.	5			6			7			8		
1	05/11/90	DIRN												
2	20.2.91	11622												
3	12.3.91	11673												

CHANGES TO BE NOTIFIED TO:— (TICK)

POST OFFICE

P.D.S.

2

MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	REQ'D FOR	A.C. No.

26 28 31 33 42 44 56 58 60

START	STORE	TITLE	SHEET	ASSEMBLY No.
COMPLETE		MAIN PCB ASSY	2 OF 9	6430-567 DET 5.2

ITEM No.	DESCRIPTION	DATA TYPE 1 2	PART No. 4—14	QTY PER ASSY.	UNIT 24—25	ISS QTY. 18—22	ACT QTY. 18—22
R12	RESISTOR 28R7 - 0·5 - 1W		26836-934	2	EA		
R13	RESISTOR 5K11 - 1 - 0·25W		26900-066	2	EA		
R14	RESISTOR 4K7 - 1 - 0·25W		26900-136	2	EA		
R15	AS R5						
R16	AS R3						
R17	AS R3						
R18	RESISTOR 287R - 0·5 - 0·5W		26836-935	2	EA		
R19	AS R3						
R20	RESISTOR 220K - 1 - 0·25W		26900-172	1	EA		
R21	AS R3						
R22	AS R3						
R23	AS R3						
R24	AS R5						
R25	RESISTOR 2K87 - 0·5 - 0·25W		26836-936	2	EA		
R26	AS R4						
R27	AS R3						
R28	AS R6						
R29	AS R10						

MF 1

ISS.	DATE	CN. No.	5		
1	05/11/90	DIRN	6		
2	12.3.91	11673	7		
3			8		
4			9		

CHANGES TO BE NOTIFIED TO:— (TICK)

POST OFFICE

P.D.S.

RIDDLE

A4

MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	RECD FOR	A.C. No.

26 28 31 33 42 44 58 59 60

START	STORE	TITLE	SHEET	ASSEMBLY No.
COMPLETE		MAIN PCB ASSY	3 OF 9	6430-507 DET 5/2

ITEM No.	DESCRIPTION (DATA TYPE 1 2)	PART No. 4—14	QTY PER ASSY.	UNIT 24—25	ISS. QTY 26—27	ACT. QTY 28—29
R30	AS R10					
R31	AS R13					
R32	RESISTOR 1M-1-0·25W	26900-127	2	EA		
R33	AS R3					
R34	AS R3					
R35	AS R32					
R36	AS R3					
R37	AS R3					
R38	AS R6					
R39	RESISTOR 68K-1-0·25W	26900-232	1	EA		
R40	RESISTOR 18K-1-0·25W	26900-236	1	EA		
R41	RESISTOR 24K-1-0·25W	26900-161	1	EA		
R42	AS R3					
R43	POTENTIOMETER 2K-20-CMPT	26950-001	1	EA		
R44	AS R12					
R45	AS R5					
R46	RESISTOR 1K-1-0·25W	26900-049	3	EA		
R47	AS R46					

MF 1

A4

ISS.	DATE	CN. No.	5			6			7			8			9		
1	05.11.90	DIRN															
2																	
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CHANGES TO BE NOTIFIED TO:— (TICK)

POST OFFICE

P.D.S.

BIDDLE

MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	REQ'D FOR	A/C No.

26 28 31 33 42 44 56 58 63

START	STORE	TITLE	SHEET	ASSEMBLY No.
COMPLETE		MAIN PCB ASSY	4 OF 9	6430-567 DET 5/2

ITEM No.	DESCRIPTION (DATA TYPE 1 2)	PART No. 4—14	QTY PER ASSY.	UNIT 24—25	ISS QTY 18—22	ACT QTY 18—22
R48	RESISTOR 12K0-1-0·25W	26900-212	1	EA		
R49	RESISTOR 470K-1-0·25W	26900-134	1	EA		
R50	AS R18					
R51	NOT USED					
R52	RESISTOR 3K-1-0·25W	26900-258	1	EA		
R53	AS R25					
R54	AS R14					
R55	RESISTOR 12K4-1-0·25W	26900-170	1	EA		
R56	RESISTOR 3K01 - 1-0·25W	26900-060	1	EA		
R57	RESISTOR 1K1 - 1-0·25W	26900-050	1	EA		
R58	AS R3					
R59	AS R46					
R60	AS R6					
R61	AS R3					
R62	RESISTOR 680R - 1- 0.25W	26900-200	1	EA		
R63	AS R4					

MF 1

ISS.	DATE	CN. No.	5		
1	05/11/90	DIAN	6		
2	02/01/91	11510	7		
3	20.2.91	11622	8		
4	12.3.91	11673	9		

CHANGES TO BE NOTIFIED TO:— (TICK)

POST OFFICE

P.D.S. 2

BIDDLE

A4

MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	REQ'D FOR	A/C No.

26 [x] 29 31 | 33 42 | 44 66 | 68 69

START	STORE	TITLE	SHEET	ASSEMBLY No.
COMPLETE		MAIN PCB ASSY	5 OF 9	6430-567 DET 5/2

ITEM No.	DESCRIPTION	DATA TYPE 1 2 [1]	PART No. 4—14	QTY PER ASSY.	UNIT 24—25	ISS QTY. 26—27	ADJ QTY. 28—29
C1	CAPACITOR 10µF-16DC-E-A		27889-950	2	EA		
C2	CAPACITOR 100nF-25DC-CE		27889-936	5	EA		
C3	AS C2						
C4	AS C1						
C5	CAPACITOR 1nF-63DC-PE		26970-100	2	EA		
C6	AS C2						
C7	AS C5						
C8	CAPACITOR 100nF-63DC-PE		27889-827	2	EA		
C9	CAPACITOR 47µF-63DC-E(U)-		27889-830	2	EA		
C10	AS C9						
C11	CAPACITOR 4·7µF-63DC-E(V)		27889-820	1	EA		
C12	CAPACITOR 470µF-25DC-E(V)S		26970-088	1	EA		
C13	AS C2						
C14	CAPACITOR 100µF-16DC-E(V)		27889-919	2	EA		
C15	AS C8						
C16	AS C2						
C17	AS C14						

MF 1

ISS.	DATE	CN. No.	5			CHANGES TO BE NOTIFIED TO:— (TICK)	
1	05/11/90	DIRN	6				
2			7			POST OFFICE	
3			8			P.D.S.	
4			9			BIDDLE	

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MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	RECD FOR	A.C. No.

25 28 31 33 42 44 58 59 60

START	STORE	TITLE	SHEET	ASSEMBLY No
COMPLETE		MAIN PCB ASSY	6 OF 9	6430-567 DET 5/2

ITEM No.	DESCRIPTION (DATA TYPE 1 2)	PART No. 4—14	QTY PER ASSY.	UNIT 24—25	ISS. QTY 18—20	ISS. QTY 18—20
D1	DIODE D-1N4148	28433-801	10	EA		
D2	AS D1					
D3	AS D1					
D4	DIODE D-1N4007	28863-082	2	EA		
D5	ZENER DIODE ZD-1N5370B	28920-035	2	EA		
D6	AS D1					
D7	AS D4					
D8	ZENER DIODE ZD-BZX79C2V4	28863-260	2	EA		
D9	AS D5					
D10	AS D1					
D11	ZENER DIODE ZD-1N821	28920-022	2	EA		
D12	AS D1					
D13	AS D1					
D14	AS D1					
D15	ZENER DIODE ZD-BZX79C3V3	28473-207	2	EA		
D16	AS D 5					
D17	AS D8					

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ISS.	DATE	CN. No.	5		
1	05/11/90	DIRN	6		
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CHANGES TO BE NOTIFIED TO:— (TICK)

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BIDDLE

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MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	REQ'D FOR	A/C No

26 [x] 28 31 33 42 41 56 58 63

START	STORE	TITLE	SHEET	ASSEMBLY No
COMPLETE		MAIN PCB ASSY	7 OF 9	6430-567 DET 5/2

ITEM No.	DESCRIPTION (DATA TYPE 1 2)	PART No. 4—14	QTY PER ASSY. 21—23	UNIT	ISS. CT. 18—20	ACT. CT. 15—17
D18	AS D11					
D19	AS D1					
D20	DIODE D-BA159	28863-160	4	EA		
D21	AS D20					
D22	ZENER DIODE ZD-1N5346B	28863-307	2	EA		
D23	AS D22					
D24	AS D20					
D25	AS D20					
D26	ZENER DIODE ZD-BZX 79C7V5	28862-891	1	EA		
D27	AS D1					
D28	ZENER DIODE ZD-BZX 79C5V6	28474-273	1	EA		
1						
TR1	TRANSISTOR TR-BC 184C	28862-961	2	EA		
TR2	AS TR1					
TR3	TRANSISTOR TR-MPSA42	28940-002	4	EA		
TR4	AS TR3					
TR5	TRANSISTOR TR-MPSA92	28940-014	3	EA		

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ISS.	DATE	CN. No.	5		
1	08/11/90	DRN	6		
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CHANGES TO BE NOTIFIED TO:— (TICK)

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MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	RECD FOR	A.C. No.

25 28 31 33 42 44 56 58 60

START	STORE	TITLE	SHEET	ASSEMBLY No.
COMPLETE		MAIN PCB ASSY	8 OF 9	6430-567 DET 5/2

ITEM No.	DESCRIPTION	DATA TYPE 1 2	PART No. 4—14	QTY PER ASSY.	UNIT 24—26	ISS CT. 18—22	ACT. QTY. 18—22
TR6	AS TR5						
TR7	AS TR3						
TR8	TRANSISTOR TR-BC214C		28862-960	1	EA		
TR9	TRANSISTOR TR-BF470		28940-027	1	EA		
TR10	AS TR5						
TR11	TRANSISTOR TR-BF469		28940-026	1	EA		
TR12	AS TR3						
TR13	TRANSISTOR TR-UNO300m		20000-300	1	EA		
TR14	NOT USED						
IC1	PROGRAMABLE OP-AMP 7612-ICL		20000-612	2	EA		
IC2	DUAL OPTO ISOLATOR 6-MCT		28900-045	1	EA		
IC3	AS IC1						
IC4	REGULATOR 4194-RC		28863-222	1	EA		
IC5	PROGRAMABLE TIMER 4541-CD		20000-541	1	EA		
IC6	OPTO ISOLATOR 2-MCT		28900-044	1	EA		
IC7	BIFET OP-AMP 3140E-CA		20000-140	1	EA		

MF 1

ISS.	DATE	CN. No.	5		
1	05/11/90	DIRN	6		
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CHANGES TO BE NOTIFIED TO:— (TICK)

POST OFFICE

P.D.S.

RIDDLE

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MEGGER INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	REC'D FOR	A.C. No

26 28 31 33 42 44 56 58 60

START	STORE	TITLE	SHEET	ASSEMBLY No
COMPLETE		MAIN PCB ASSY	9 OF 9	6430-567 DET 5/2

ITEM No.	DESCRIPTION	DATA TYPE 1 2	PART No. 4—14	QTY PER ASSY.	UNIT 24—25	ISS. QTY 26—27	ACT. QTY 28—29
IC8	SWITCHING VOLTAGE REGULATOR 1072CT-LT		25900-079	1	EA		
BR1	NOT USED						
T1	INVERTOR TRANSFORMER ASSY		6131-870	1	EA	APL	
FS1	FUSE 100 mA CERAMIC (QB)		25413-295	2	EA		
FS2	FUSE 1A		25413-284	1	EA		
FS3	AS FS1						
PL4	YUASA BATTERY PLUG PL,2-WAY-JST		25960-043	1	EA		

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ISS.	DATE	CN. No.	5		
1	05/11/90	DIRN	6		
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CHANGES TO BE NOTIFIED TO:— (TICK)

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RIDDLE

ASSEMBLY PARTS LIST INDEX

FILE No. 694

PRODUCT DET 3/2 BIDDLE (250302)

SHEET 1 OF 1

	PART No.	DESCRIPTION	PART No.	DESCRIPTION
1	6410-651	STATION LIST (NO DRG)	6470-129	CIRCUIT DIAGRAM
2	6410-652	INSTRUMENT ASSY	6171-554	FINAL INSPECTION TEST SPEC
3	6430-566	MAIN PCB ASSY	6171-514	PRODUCTION TEST SPEC
4	6430-587	DISPLAY PCB ASSY	6171-515	TECHNICAL DESCRIPTION
5	6430-427	GENERATOR ASSY (NO DRG)	6171-573	ATE/FUNCTIONAL PCB T's
6	6331-502	CASE REAR ASSY	6171-572	INVERTER TRANSFORMER T's
7	6131-717	BOBBIN ASSY		
8	6131-870	TRANSFORMER ASSY		
9	6131-873	CONNECTOR ASSY(20 WAY)		
10	6131-765	LAMINATIONS ASSY		

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ISS.	DATE	CN. No.			
1	18/01/91	DIRN	5		
2	15.2.91	11608	6		
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DEV. REF. | A | B | C | D | E | F | G | H | J | K | L |

CHANGES TO BE NOTIFIED TO:— (TICK)

- POST OFFICE
- P.D.S.
- BIDDLE
- N.C.B.

BIDDLE INSTRUMENTS LIMITED

INST.	W.O. No.	DATE	BATCH	REQ'D FOR	A/C. No.

26 28 31 33 42 44 56 58 63

START	STORE	TITLE	SHEET	ASSEMBLY No.
COMPLETE		STATION LIST (NO DRG)	1 OF 1	6410-651 DET 3/2 BIDDLE

ITEM No.	DESCRIPTION (DATA TYPE 1 2 [1])	PART No. 4—14	QTY PER ASSY.	UNIT 24—26	ISS. QTY. 18—22	ACT. QTY. 8—22
1	INSTRUMENT ASSY	6410-652	1	EA	APL	
2	TERMINAL POST ADAPTOR, RED	6320-207	2	EA		
3	TERMINAL POST ADAPTOR, BLACK	6320-206	2	EA		
4	CARTON LABEL OUTER	5172-355	1	EA		
5	PACKING PIECE	6460-043	1	EA		
6	PACKING BOX	6360-067	1	EA	-	

MF 1

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ISS.	DATE	CN. No.					
1	18/01/91	DIRN	5			6	
2			7				
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DEV. REF. | A | B | C | D | E | F | G | H | I | K | L | NCR

CHANGES TO BE NOTIFIED TO:— (TICK)

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P.D.S. | | |

BIDDLE | | |

INST.	W.O. No.	DATE	BATCH	RECD FOR	A.C. No.

25 [x] 28 [ ] 31 [ ] 33 [ ] 42 44 [ ] 56 58 [ ] 63

START	STORE	TITLE	SHEET	ASSEMBLY No.
COMPLETE		INSTRUMENT ASSY (SEE DRG 6410-645)	1 OF 2	6410-652 DET 3/2 BIDDLE

ITEM No.	DESCRIPTION (DATA TYPE 1 2)	PART No. 4—14	QTY PER ASSY.	UNIT 24—25	ISS. QTY 16—22	ACT. QTY 16—22
1	FRONT COVER MODIFIED	5210-354	1	EA		
2	SPRING DOWEL	21128-008	2	EA		
3	RANGE KNOB	5110-356	1	EA		
4	INDEX SPIDER	5410-082	1	EA		
5	PLASTITE SCREW N°4 x 3/8" PAN HD	21264-228	2	EA		
6	CARRYING HANDLE	5410-118	1	EA	-	
7	DISPLAY PCB ASSY	6430-587	1	EA	APL	
8	SCREEN	5140-830	1	EA		
9	SPACING BOSS	5152-023	2	EA		
10	POLYMATE SCREW N°2 x 3/8" PAN HD	21264-234	2	EA		
11	PLASTITE SCREW N°4 x 1/4" PAN HD	21264-229	5	EA		
12	CASE REAR ASSY	6331-302	1	EA	APL	
13	BATTERY COVER	5410-125	1	EA		
14	FASTENER	21189-007	1	EA		
15	INSTRUCTION LABEL	5270-517	1	EA		
16	GENERATOR ASSY	6430-427	1	EA	APL	
17	SILICONE GREASE (MS4)	17641-654	A/R			
18	SEALING RING	5210-253	1	EA		

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ISS.	DATE	CN. No.	5		
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CHANGES TO BE NOTIFIED TO:— (TICK)

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DEV. REF. | A | B | C | D | E | F | G | J | K | NCR |

INST.	W.O. No.	DATE	BATCH	REC'D. FOR	A/C. No.

25 * 23 31 33 42 43 56 58 63

START	STORE	TITLE	SHEET	ASSEMBLY No.
COMPLETE		INSTRUMENT ASSY (SEE DRG 6410-645)	2 OF 2	6410-652 DET 3/2 BIDDLE

ITEM No.	DESCRIPTION (DATA TYPE 1 2)	PART No. 4—14	QTY PER ASSY.	UNIT 24—25	ISS. QTY. 18—22	ACTL. QTY. 18—22
19	SWITCH ARM	5410-032	2	EA		
20	SPRING	5160-266	8	EA		
21	DUMMY CONTACT (PLASTIC)	5210-218	2	EA		
22	CONTACT	5230-343	6	EA		
23	MAIN PCB ASSY	6430-566	1	EA	APL	
24	CONTACT OIL	17613-523	A/R		-	
25	SHAFT EXTENSION	5210-252	1	EA		
26	CONNECTOR ASSY	6131-873	1	EA	APL	
27	WINDOW LABEL	5173-236	1	EA		
28	RANGE LABEL	5270-516	1	EA		
29	SERIAL Nº LABEL	5172-161	3	EA		
30	CAP HD SCREW M3 x 25 mm	21816-587	4	EA		
31	FOOT	22400-001	4	EA		
32	CABLE CLIP (SELF ADHESIVE)	25945-025	1	EA		
33	BEZEL (SHORT)	25975-018	2	EA		

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ISS.	DATE	CN. No.	5		
1	18/01/91	DIRN	6		
2			7		
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DEV. REF.	A	B	C	D	E	F	G	H	J	K	L

CHANGES TO BE NOTIFIED TO:— (TICK)

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ACCO USA
WHEELING, ILLINOIS 60090
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MADE IN USA

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